Trauma-Informed Mindful Embodied (TIME) Yoga for Childhood Trauma Survivors: Self-Regulation During a Global Pandemic

by

Kristen Silveira
B.A., Queen's University, 2014
M.Sc., University of Victoria, 2016

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We acknowledge with respect the lək̓ʷəŋən peoples on whose traditional territory the university stands and the Songhees, Esquimalt and W̱SÁNEĆ peoples whose historical relationships with the land continue to this day.

Supervisory Committee

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Abstract

Survivors of complex childhood trauma (CCT) tend to develop distinctive mental health challenges later on in adulthood, which may be exacerbated by the ongoing coronavirus pandemic. CCT survivors often struggle with self-regulation, making it difficult to tolerate the distress associated with "gold-standard" trauma-processing therapies for survivors of single-incident and adult-onset trauma. Yoga can enhance self-regulation, through physical movements, breathing techniques, meditative focus, and ethical guidelines of behaviour. This dissertation encompasses the creation of a new approach for teaching yoga to trauma survivors, called TIME yoga. This approach is based on a neuropsychological understanding of the bio-psycho-social alterations that CCT survivors undergo. Chapter 1 details the methods employed in this series of dissertation studies. A randomized controlled trial (RCT) was conducted with 26 adult survivors of CCT. Mental health, emotional functioning, resilience, and cognitive functioning were assessed via subjective and objective measures at two time points (i.e., pre- and post-participation in the online yoga program or waitlist). Chapter 2 is a retrospective and cross-sectional study describing survivors' pre-intervention psychological and cognitive functioning during the pandemic, and evaluating the impact of trauma at particular developmental stages. Regression analyses revealed particular implications of adolescent and young-childhood trauma. Chapter 3 presents a manual of TIME yoga and feasibility data from the initial RCT, supporting both feasibility and safety of the program. Chapter 4 underscores yoga-related improvements in depressive symptoms, interoceptive awareness, and executive functioning. Using both repeated-measures ANOVAs and clinically meaningful indicators of change, this study illustrates how TIME yoga effectively improved survivors' self-regulation during the global health crisis. Future directions for program development and evaluation are discussed.

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Dedication

"I've learned that people will forget what you said, people will forget what you did, but people will never forget how you made them feel" – Maya Angelou

For my loved ones, who have co-created with me moments of safety, curiosity, and joy.

Prologue

This dissertation is a series of three papers representing the development and initial evaluation of a new trauma-informed (and neuropsychologically-informed) yoga intervention to improve self-regulation among trauma survivors. This research undertaking was partially inspired by K.Silveira and colleagues' (2020) systematic review of neuropsychological functioning among trauma survivors, which contributed to an understanding of self-regulation as a likely mechanism of neuropsychological change. Adult survivors of childhood trauma are the particular focus of this dissertation, given the neurobiological vulnerabilities and core self-regulation difficulties in this population, and the potential exacerbation of these difficulties as a result of the COVID-19 pandemic and its resemblance to childhood adversities. Beginning with Chapter 1, this dissertation outlines the methods for the randomized controlled trial that is referenced across all three subsequent chapters. Chapters 2, 3, and 4 are three papers representing the unfolding research process behind TIME yoga's development, including: (1) identifying how trauma at particular stages of development affects self-regulation (i.e., psychological and cognitive functioning) during the COVID-19 pandemic; (2) building rationale for a new yoga program to address self-regulatory challenges among childhood trauma survivors, including an exploration of the program's feasibility; and (3) examining the program's effectiveness for improving survivors' self-regulation. Although these papers are facets of the same program development project, each of them will be submitted individually for publication; thus, throughout the dissertation, the reader will notice perhaps redundant threads regarding trauma, neuropsychological functioning, mindfulness-based interventions, and the pandemic. The following table of abbreviations is included to enhance readability throughout the chapters.

Table 1.00

Abbreviations Frequently Appearing in this Dissertation

Abbreviation	Corresponding Word or Phrase
General	
ANS	Autonomic nervous system
ACC	Anterior cingulate cortex
ACE	Adverse childhood experience
CCT	Complex childhood trauma
COVID	Coronavirus
DBT	Dialectical behaviour therapy
DSM	Diagnostic and Statistical Manual of Mental Disorders
EF	Executive functions
GAD	Generalized anxiety disorder
GUTS	Generalized unsafety theory of stress
HRV	Heart rate variability
ICD	International Classification of Diseases
ISTSS	International Society for Traumatic Stress Studies
MBI	Mindfulness-based intervention
MDD	Major depressive disorder
PAG	Periaqueductal gray
PFC	Pre-frontal cortex
PTG	Post-traumatic growth
PTSD	Post-traumatic stress disorder
TIME	Trauma-Informed Mindful Embodied
TSY	Trauma-Sensitive Yoga
RCT	Randomized controlled trial
Self-Report Measures	
ACS	Attentional Control Scale
BRS	Brief Resilience Scale
EFI	Executive Function Index
ERQ	Emotion Regulation Questionnaire
GAD-7	Generalized Anxiety Disorder 7-Item Scale
LEC-5	Life Events Checklist for DSM-5
MAIA	Multidimensional Assessment of Interoceptive Awareness
PCL-5	PTSD Checklist for DSM-5
PHQ-9	Patient Health Questionnaire
PTGI	Post-Traumatic Growth Inventory
TAQ	Traumatic Antecedents Questionnaires
TAS-20	Toronto Alexithymia Scale
Data Analyses	
ANCOVA	Analysis of covariance
FDR	False discovery rate
IIV	Intra-individual variability

ISD	Intra-individual standard deviation
MCC	Matthew's correlation co-efficient
RT	Reaction time

Chapter 1: Dissertation methods

Methods

Participants

Participants were recruited via flyers shared electronically with local organizations (e.g., transition houses, sexual assault centers, private or non-profit health and wellness practices), via postings on the portal for the University of Victoria Psychology Participant Pool, as well as the ReachBC platform, which helps to connect researchers with potential participants. Survivors expressing interest in the study were screened by phone, and were deemed eligible if they (1) were between 18 and 60 years of age; (2) endorsed exposure to childhood or adolescent trauma within their relationship with a caregiver, close relative, or significant person in their life (e.g., enduring verbal, emotional, physical, or sexual abuse; witnessing domestic violence; witnessing a caregiver struggle with a serious mental illness or substance use problem; having a caregiver who was imprisoned; losing or being abandoned by a caregiver; or feeling neglected or as if needs for food, personal hygiene, health, safety, or love were not met); (3) were fluent in English; (4) had normal or corrected vision and hearing abilities; (5) resided in British Columbia within the Island Health or Vancouver Coastal Health regions; and (6) could access a computer at home with an Internet connection and a keyboard.

Additional exclusion criteria were pertinent to the yoga intervention aspect of the study. Participants were excluded if they (1) self-reported a current severe mental illness (i.e., schizophrenia spectrum and other psychotic disorders, bipolar disorder, substance use disorder); (2) had a medical condition, pregnancy, or physical disability that significantly limits ability to do yoga postures; (3) previously completed a trauma-informed yoga program; (4) had a consistent seated or moving meditation practice within the past five years (i.e., practiced at least once per week for one hour for a three-month period); (5) experienced a trauma or crisis within

the preceding 3 months, apart from events related to COVID-19; or (6) were determined to be at imminent risk for self-harm, on the basis of reporting self-harming behaviour or suicidal intent and plan within the preceding few weeks. The latter two criteria were implemented in order to ensure participants were adequately resourced, because any meditation or yoga intervention can evoke feelings which overwhelm participants' adaptive coping strategies.

Of the 40 individuals who expressed interest and were screened, nine were ineligible due to: location of residence (4), recent crisis (2), lack of childhood trauma exposure (1), substance abuse (1), or existing yoga practice (1). Five eligible individuals did not return the informed consent form or participate in the study. The final sample consisted of 26 participants, for whom demographic and other health and lifestyle information is displayed in Table 1.01. While participants were recruited through various community agencies, 80% of participants in the final sample were undergraduate students recruited via the University of Victoria's participant pool.

Table 1.01

Demographic and Other Health and Lifestyle Information (n = 26)

	M	*SD*	Range	Frequency (%)
Demographic				
Age (years)	24.69	8.20	18 – 48	
Sex (*n*=25)				92% female; 8% male
Gender				84.6% female; 11.5% male; 3.8% gender queer/non-conforming
Ethnicity				76.9% Caucasian; 11.5% Asian; 7.7% Indigenous; 3.8% African Canadian
Education				57.7% some post-secondary; 15.4% undergraduate degree; 15.4% high-school diploma; 11.5% college diploma
Annual income below $15,000				76.9%
Health and lifestyle				
Has spiritual or religious practice				15.4%
Tried moving meditation				53.8%
Prior regular moving meditation practice				11.5%

Tried seated meditation				57.7%
Prior regular seated meditation practice				11.5%
History of head injury				19.2%
Physical exercise (hrs per week)	5.52	7.66	0 – 40	
Sleep (hrs per night)	7.56	1.30	6 – 12	
Smokes cigarettes				15.4%
Drinks alcohol				80.8%
Uses marijuana				19.2%

Mental Health History

Self-reported mental health histories are outlined in Table 1.02, including the percentage of participants endorsing various mental illnesses either currently or in the past, and whether they were professionally or self-diagnosed. Most of the sample (80.8%) reported struggling with a mental health condition in their lifetime, for which a majority (69.2%) indicated accessing some form of treatment in their lifetime.

Table 1.02

Percentage of Self-Reported Mental Illnesses by Timeframe and Diagnostic Method

Mental Illness	Timeframe		Diagnostic Method	
	Current	Past	Professionally diagnosed	Self-diagnosed
Anxiety	42.3	23.1	46.2	23.1
Depression	23.1	30.8	34.6	19.2
Attention-deficit hyperactivity disorder	15.4	53.8	19.2	0
Post-traumatic stress disorder	15.4	15.4	26.9	0
Eating disorder	7.7	19.2	7.7	19.2
Learning disorder	7.7	3.8	7.7	3.8
Substance abuse	3.8	7.7	7.7	7.7
Dissociative disorder	3.8	3.8	0	7.7
Developmental disorder	3.8	0	0	3.8
Obsessive-compulsive disorder	3.8	0	0	3.8
Personality disorder	0	3.8	3.8	0
Other mental illness(es)	0	3.8	0	3.8
Bipolar disorder	0	0	0	0
Psychosis	0	0	0	0
Disruptive, impulse-control, and conduct disorders	0	0	0	0

Note. For each mental illness, the cumulative percentage for timeframe or diagnostic method is not necessarily 100, due to "NA" or missing responses.

Experiences With COVID-19

At the time of study commencement, only one participant (3.8%) within the sample considered themselves at high-risk for developing severe symptoms with COVID-19 infection. Regarding adherence to public health guidelines, all participants were practicing social distancing (i.e., limiting in-person contact and keeping a 2-metre distance from others). The longest continuous time in which participants social distanced ranged from 1 to 210 days. 57.7% of participants stated they had practiced self-isolation (i.e., staying home and maintaining distance from household members); their longest self-isolation period ranged from 8 to 112 days, with a modal 14-day period. One participant indicated they were placed under a mandatory 14-day quarantine in which they self-isolated due to either travel or COVID-19 exposure/symptoms.

23.1% of the sample stated they had developed viral or flu-like symptoms during the pandemic, and 11.5% experienced respiratory symptoms in particular. None of the participants tested positive for COVID-19 or believed they had the virus, or were hospitalized for any reason during the pandemic. 34.6% of participants indicated that their loved one(s) developed viral or flu-like symptoms during the pandemic, and 26.9% stated that loved one(s) experienced respiratory symptoms. 11.5% said that their loved one(s) tested positive for COVID-19, and 3.8% said they were not tested but likely had the virus. 15.4% reported their loved one(s) were hospitalized during the pandemic, and 11.5% reported hospitalizations due to COVID-19 in particular. 7.7% of participants suffered the loss of a loved one during the pandemic, with causes of death other than COVID-19. 34.6% of participants were aware of an acquaintance who tested positive for COVID-19, and none were aware of an acquaintance dying due to the virus.

With respect to participants' living and financial situations, 15.4% of the sample reported living alone, and 7.6% noted having dependents. 50.0% of participants reported a substantial loss

of income as a result of the pandemic. 23.1% reported losing their jobs, and the same percentage reported difficulty paying for necessities such as rent, food, or medication. Four participants (15.4%) identified as healthcare workers, working a range of 12 to 45 hours weekly, which for three of the participants represented a pandemic-related increase in hours, and for two of the participants included primarily in-person patient contact. Another four participants were non-healthcare essential workers, working on-site during the pandemic, with hours ranging from 10 to 50 per week (representing an increase in hours for one participant).

Most participants reported using the following strategies to cope with stress related to COVID-19, and one participant stated they were not using any strategies: socially-distanced communication with loved ones (84.6%); creative activities (84.6%); spending time in nature (80.8%); exercising outdoors (73.1%); limiting exposure to COVID-19 information (61.5%); staying informed about COVID-19 updates (57.7%); exercising at home (57.7%); maintaining a daily routine (57.7%); eating healthily (50.0%); helping others in need (38.5%); accessing counselling (30.8%); and spiritual practice (19.2%).

Self-Report Measures

Trauma Exposure

Lifetime experiences of trauma were assessed with two measures (Appendix A).

Traumatic Antecedents Questionnaire (TAQ; Luxenberg et al., 2001). The TAQ is a self-report measure that captures overt and subtle forms of interpersonal and caregiving disruptions, as well as protective experiences and personal resiliency. The TAQ consists of 41 items querying frequency of experiences in 10 domains: Competence; Safety; Neglect; Separations; Emotional Abuse; Physical Trauma; Sexual Trauma; Witnessing Trauma; Other Traumas (e.g., natural disaster, serious accident); and Alcohol and Drugs (i.e., exposure to

familial or personal substance use). Experiences in each domain are retrospectively assessed according to four distinct age ranges: young childhood (birth to 6 years); school age (7 to 12 years); adolescence (13 to 18 years); and adulthood. While psychometric analysis of the TAQ is ongoing, preliminary evidence suggests that cumulative early childhood and adolescent trauma, as measured by the TAQ, is a critical determinant of complex trauma symptomology in adulthood. Given that the TAQ is a clinical tool and is not yet validated for research purposes, in the current study, participants' responses on the TAQ were converted to an ACE burden score for the three age ranges of young childhood, school age, and adolescence. The method of this conversion is outlined below under Data Analyses and Synthesis.

Life Events Checklist for DSM-5 (LEC-5; Weathers, Blake, et al., 2013). The standard LEC-5 is a 17-item self-report questionnaire that allows respondents to indicate a variety of potentially traumatic events they have experienced in their lifetime. For each queried event, respondents indicate if: the event happened to them, they witnessed it, they learned about it, it was part of their job, they are unsure, or it does not apply. Two questions from the extended LEC were incorporated: (1) if participants endorsed experiencing an "other very stressful event or experience", they were prompted to briefly described the event; and (2) they were asked to briefly describe the worst event among those endorsed on the checklist, along with age of exposure. The original LEC is a sound screening measure of trauma exposure, with adequate test-retest reliability, convergent validity, and criterion validity in undergraduate and veteran samples (Gray et al., 2004). The LEC-5's psychometric properties are not currently available, but are expected to be similarly acceptable, given minimal revisions from the original LEC measure.

Mental Health

Three measures examined symptomology of trauma-related mental health difficulties (i.e., PTSD, anxiety, depression; Appendix A).

PTSD Checklist for DSM-5 (PCL-5; Weathers, Litz, et al., 2013). The 20 items of the PCL-5 correspond with the 20 DSM-5 symptoms of PTSD. Participants indicate how much they have been bothered by each symptom in the past month, on a scale from 0 (*not at all*) to 4 (*extremely*). A threshold of 33 points can be used to determine a provisional PTSD diagnosis. Change indices are expected to be similar to those recommended for the PCL for DSM-IV, with a 5-point change representing reliable change in response to treatment. Blevins and colleagues (2015) report that the PCL-5 is psychometrically sound, exhibiting strong internal consistency, test-retest reliability, and convergent and discriminant validity in a sample of trauma-exposed college students. In the present sample, internal consistency of the PCL-5 was good ($\alpha = .89$).

Patient Health Questionnaire (PHQ; Kroenke et al., 2001). The PHQ-9 is a 9-item scale on the PHQ, evaluating diagnoses of depressive disorders and symptom severity. Items are scored from 0 (*not at all*) to 3 (*nearly every day*) to indicate frequency of symptoms within the past two weeks. The items correspond to the DSM-IV symptom criteria for major depressive disorder. Symptom severity can range from 0 to 27. A threshold of 10 points is commonly recommended to detect depression (Manea et al., 2012). The PHQ-9 is also responsive to treatment outcome, with a minimum 5-point change indicating clinically meaningful change (Löwe et al., 2004). In addition to its diagnostic utility, the PHQ-9 is a psychometrically strong measure of depressive severity, with established reliability as well as internal and external validity. The PHQ-9 demonstrated good internal consistency in the current sample ($\alpha = .82$).

Generalized Anxiety Disorder 7-item Scale (GAD-7; Spitzer et al., 2006). This 7-item anxiety measure examines presence and severity of generalized anxiety disorder (GAD) – one of the most prevalent mental disorders among outpatients. Similar to the PHQ-9, items are rated according to frequency within the past two weeks, ranging from 0 (*not at all*) to 3 (*nearly everyday*). A score of 10 or higher indicates a probable GAD diagnosis, as per DSM-IV criteria. Furthermore, increasing scores reflect greater severity of generalized anxiety. Recent evidence suggests using a 6-point reliable change index (Bischoff et al., 2020). Overall, Spitzer and colleagues' (2006) measure has established good reliability and validity, and is responsive to treatment. In the present sample, the GAD-7 demonstrated good internal consistency ($\alpha = .88$).

Emotional Functioning

Multiple contributors to emotion regulation and overall well-being were assessed with questionnaires (Appendix A): emotion regulation strategies, interoception, and alexithymia.

Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). The ERQ consists of 10 items across two scales, measuring the use of cognitive reappraisal (e.g., "When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm") and emotional suppression (e.g., "I keep my emotions to myself"). Each item is rated on a Likert-type scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Scale scores can range from 1 to 7. In the original undergraduate validation samples, women and men scored significantly differently on the Supression scale, with respective means of 3.14 ($SD = 1.18$) and 3.64 ($SD = 1.11$). Mean scores on the Reappraisal scale did not differ by gender (for women, $M = 4.61$; $SD = 1.02$). Gross and John (2003) describe good psychometric properties, including internal consistency, test-retest reliability, and convergent and discriminant validity. In the present sample, both scales had good internal consistency ($\alpha = .85$).

Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012). The MAIA is a 32-item self-report questionnaire which measures eight dimensions of interoceptive awareness on a Likert-type scale ranging from 0 (*never*) to 5 (*always*): (1) Noticing (e.g., "When I am tense I notice where the tension is located in my body"); (2) Non-Distracting (e.g., reverse-scored "When I feel pain or discomfort, I try to power through it); (3) Not Worrying (e.g., reverse-scored "When I feel physical pain, I become upset"); (4) Attention Regulation (e.g., "I can pay attention to my breath without being distracted by things happening around me"); (5) Emotional Awareness (e.g., "I notice how my body changes when I am angry"); (6) Self-Regulation (e.g., "I can use my breath to reduce tension); (7) Body Listening (e.g., "I listen to my body to inform me about what to do"), and (8) Trusting (e.g., "I trust my body sensations"). Mehling and colleagues report adequate construct validity and internal consistency in an initial validation sample of students and instructors of mind-body practices. Mean scale scores were relatively high in the initial sample; on a possible scale of 0 to 5, the lowest score was 3.20, for Non-Distracting, and the highest was 4.16, for Emotional Awareness. In the present study, internal consistency ranged across subscales, from excellent for Body Listening ($\alpha = .95$), Emotional Awareness ($\alpha = .92$), Self-Regulation ($\alpha = .91$), and Attention Regulation ($\alpha = .91$), and good for Trusting ($\alpha = .87$) and Noticing ($\alpha = .84$), to poor for Non-Distracting ($\alpha = .55$), and unacceptable for Not Worrying ($\alpha = .27$). For Non-distracting, item 7 (reverse-scored "When I feel pain or discomfort, I try to power through it") was removed from the scale in order to increase Cronbach's alpha from .55 to .64; the remaining reverse-scored scale items were: "I do not notice (I ignore) physical tension or discomfort until they become more severe" and "I distract myself from sensations of discomfort". Not Worrying was excluded from statistical analyses, as item deletion did not improve its Cronbach's alpha. Mehling and

colleagues (2012) suggest that based on varying correlations, the eight subscales are independent from each other. However, a recent confirmatory factor analysis by Ferentzi and colleagues (2020) demonstrates that six of the subscales measure a common interoception factor, while the Not Worrying and Non-Distracting subscales are weakly related to this *general MAIA factor.*

Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994). The TAS-20 is a self-report measure of alexithymia, consisting of 20 items rated on a 5-point Likert-type scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Three subscales comprise the TAS-20: (1) Difficulty Describing Feelings (e.g., "It is difficult for me to find the right words for my feelings"); (2) Difficulty Identifying Feelings (e.g., "I don't know what's going on inside me"), and (3) Externally-Oriented Thinking (e.g., "I prefer talking to people about their daily activities rather than their feelings"). Total scores on the TAS-20 range from 20 to 100, with scores equal to or less than 51 indicating no alexithymia, scores from 52 to 60 indicating possible alexithymia, and scores of 61 or higher indicating alexithymia. In Bagby and colleagues' (1994) undergraduate and outpatient psychiatric validation samples, scores did not significantly differ by gender, and for females were as follows: M =47.38 (SD = 10.96) for the student sample, and M = 55.27 (SD = 12.24) for the psychiatric sample. The three-factor structure of the scale has been demonstrated in both clinical and nonclinical populations, and the scale possesses good internal consistency and test-retest reliability. Internal consistency in the current sample was excellent for the total score (α = .90), good for both Difficulty Identifying Feelings (α = .84) and Difficulty Describing Feelings (α = .83), and acceptable for Externally-Oriented Thinking (α = .75).

Cognitive Functioning

Subjective attentional and executive functions (EF) were assessed with the following measures (Appendix A):

Attentional Control Scale (ACS; Derryberry & Reed, 2002). The ACS is a 20-item self-report instrument that assesses focusing (e.g., reverse-scored "When trying to focus my attention on something, I have difficulty blocking out distracting thoughts") and shifting attention (e.g., "It takes me a while to get really involved in a new task"). Items are rated on a scale from 1 (*almost never*) to 4 (*always*), and the total score can range from 20 to 80. In Judah and colleagues' (2014) validation study with undergraduate samples, the mean total score was 50.28 (*SD* = 9.39). The focusing and shifting attention factors are supported by confirmatory factor analysis and are significantly related to symptoms of anxiety and depression, respectively (Judah et al., 2014; Ólafsson et al., 2011). In a recent study by Bell and colleagues (2019), total ACS scores were significantly higher in healthy young adults after a meditation intervention relative to controls. The ACS has adequate internal consistency and criterion validity (Judah et al., 2014). In the present sample, internal consistency of the ACS was good for the total score and shifting factor (α = .89 for each) and acceptable for the focusing factor (α = .78).

Executive Function Index (EFI; Spinella, 2005). The EFI is a 27-item questionnaire that measures five EF dimensions: (1) Empathy (e.g., "I have a lot of concern for the well being of other people"; *M* = 22.8; *SD* = 4.1); (2) Strategic Planning (e.g., "I use strategies to remember things"; *M* = 23.7; *SD* = 4.4); (3) Organization (e.g., "I'm an organized person"; *M* = 18.3; *SD* = 3.7); (4) Impulse Control (e.g., reverse-scored "I swear/use obscenities"; *M* = 16.4; *SD* = 4.0); and (5) Motivational Drive (e.g., "I have a lot of enthusiasm to do things"; *M* = 14.6; *SD* = 3.0). Each item is rated on a scale from 1 (*not at all*) to 5 (*very much*), with a total score range of 27 to 135. Internal consistency as well as content and criterion validity have been demonstrated in a community sample. In the current sample, internal consistency was poor for Motivational Drive (α = .51), acceptable for Impulse Control (α = .65) and Strategic Planning (α = .73), and good for

Organization (α = .86), Empathy (α = .87), and total score (α = .87). For Motivational Drive, item 4 (reverse-scored "I can sit and do nothing for hours") was removed, and Cronbach's alpha increased from .51 to .66; remaining scale items were: "I have a lot of enthusiasm to do things", "I'm interested in doing new things", and "I tend to be an energetic person".

Resilience and Post-Traumatic Growth

Two self-report measures (Appendix A) addressed resilience more broadly, as well as post-traumatic growth in relation to the COVID-19 pandemic.

Brief Resilience Scale (BRS; Smith et al., 2008). The BRS is a 6-item measure of a single factor – the ability to bounce back or recover from stress (e.g., "I tend to bounce back quickly after hard times"). Respondents indicate the degree to which they agree with each of the statements, from 1 (*strongly disagree*) to 5 (*strongly agree*), producing a total averaged score ranging from 1 to 5. Across student and behavioural medicine samples, mean BRS scores ranged from 3.53 (*SD* = 0.68) to 3.98 (*SD* = 0.68). In these samples, the scale demonstrated good internal consistency, test-retest reliability, convergent validity, and discriminant predictive validity. The BRS demonstrated good internal consistency in the present sample (α = .81).

Post-Traumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996). This instrument consists of 21 items assessing personal growth after a stressful encounter. In the current study, participants were instructed to reflect on how they might have changed as a result of the COVID-19 crisis in particular. There are five factors: (1) New Possibilities (5 items; e.g., "I have developed new interests"); (2) Relating to Others (7 items; e.g., "I have more compassion for others"); (3) Personal Strength (4 items; e.g., "I have a greater feeling of self-reliance"); (4) Spiritual Change (2 items; e.g., "I have a better understanding of spiritual matters"); and (5) Appreciation of Life (3 items; e.g., "I changed my priorities about what is important in life").

Items are rated on a scale from 0 (*I did not experience this change as result of the crisis*) to 5 (*I experienced this change to a very great degree as a result of the crisis*). Total scores range from 21 to 105, with higher scores reflecting greater levels of positive transformation. In Tedeschi and Calhoun's (1996) original scale development sample of undergraduates endorsing a significant negative life event during the past five years, women reported significantly more post-traumatic growth (M = 75.18, SD = 21.24) than men (M = 67.77, SD = 22.07). The PTGI is the most widely used measure of post-traumatic growth, and has shown adequate factor structure and reliability across many samples of trauma survivors, including community samples and veterans (e.g., Bates et al., 2004; Palmer et al., 2012; Tedeschi & Calhoun, 1996). In the current sample, internal consistency was excellent for: the total score (α = .96), Relating to Others (α = .93), and Personal Strength (α = .91). Internal consistency was good for New Possibilities (α = .86) and Appreciation of Life (α = .85), and was acceptable for Spiritual Change (α =.64).

Demographic, Lifestyle, and Pandemic-Related Information

Two questionnaires (Appendix A) examined: demographic information, lifestyle habits, medical history, mental health and treatment history, experiences with yoga and other meditation practices, and experiences related to COVID-19. Additionally, a brief recent experiences questionnaire (Appendix A) inquired about whether participants incorporated any new self-care strategies or experienced any new disruptions related to COVID-19 during the four-week intervention or waiting period.

Intervention Feasibility

A weekly check-in email (Appendix A) inquired about treatment adherence (i.e., number of attempted yoga sessions), treatment quality (i.e., regularity of yoga schedule, quality of surrounding environment, percentage of sessions completed), and changes in risk for self-harm.

Objective Cognitive Measures

The software PsyToolkit was used for online data collection (Stoet, 2010, 2017). Participants completed three computerized cognitive tasks – the Flanker Task, N-Back Task, and Go/No-Go Task. For each task, participants were instructed to "Please respond as quickly as possible, while also minimizing errors".

Flanker Task

The Flanker Task (Eriksen & Eriksen, 1974) is an experimental measure of selective attention. In each trial, participants see five letters appear on-screen until either a response is made, or 2000 msec elapse. Participants must respond to the central letter above the fixation cross, while ignoring the other letters (i.e., the flankers). The letter X or C must be responded to by pressing a designated keyboard key, and the letter V or B must be responded to with another designated key. If participants respond correctly, the fixation cross turns green, otherwise it turns red. In congruent trials, the flankers are letters that require the same response as the central letter. In the more difficult, incongruent trials, the flankers are letters that require a different response from the central letter. The PsyToolkit version of the task varies slightly from Eriksen and Eriksen's (1974) original version, in that there is equidistant spacing between letters (versus the variable spacing in the original version), and there are no neutral letters in addition to the compatible and incompatible flankers. The task consists of 10 practice trials, and four blocks of 50 test trials, with 53.5% incongruent trials.

N-Back Task

The 2-back Task measures working memory (Kirchner, 1958). Participants view a series of letters, one trial at a time, for 500 ms followed by a 2500 ms response period. For each letter, they must indicate via key press, if the letter matches the one presented two trials ago. The area

around the letter turns green if participants press the key correctly (i.e., in response to a match), and it turns red if the key is pressed incorrectly (i.e., in response to a non-match). A practice block of 10 trials is followed by performance feedback about the number of: match trials, non-match trials, correctly matched items, missed items, and false alarms. Then, there are four blocks of 50 test trials, with 1 match trial for every 2 non-match trials. Matthews' correlation coefficient (MCC; Matthews, 1975) was calculated as a measure of accuracy on this task. This is a single index that reflects true and false positives and negatives, thus efficiently measuring performance on tasks of binary classifications, such as the N-Back task. MCC characterizes the association between observed and predicted binary classifications. The MCC can range in value between -1 (total disagreement between prediction and observation) and 1 (perfect prediction), with 0 representing a random chance-level prediction.

Go/No-Go Task

The Go/No-Go Task assesses response inhibition, attention, and working memory (e.g., Criaud & Boulinguez, 2013; Verbruggen & Logan, 2008). In each trial, participants see either "GO Press the space bar" or "NOGO Press nothing" appear on-screen until a response is made, or for up to 2000 ms. They must respond by either pressing or not pressing the designated key. If they respond incorrectly, an error message on-screen reads "ERROR You should have pressed the button, but you did not" or "ERROR You should not have pressed the button, but you did". There are 15 practice trials, and four blocks of 50 test trials, with a ratio of 4:1 Go and No-go trials. As with the N-Back task, MCC was used to index accuracy on this Go/No-Go task.

Procedures

This study was approved by the University of Victoria Human Research Ethics Board. In light of restrictions on in-person research during the COVID-19 pandemic, all data collection

occurred online. Data collection occurred early-on in the pandemic, between June and December 2020. Following the screening call, participants reviewed an electronic consent form and had an opportunity to discuss questions or concerns via phone or email before agreeing to participate.

Baseline Assessment

Participants were provided with weblinks to complete the questionnaires and cognitive tasks on the Psychology Department's instance of LimeSurvey (PsycLime) and PsyToolkit, respectively. Cognitive task order was counterbalanced across participants to control for order effects. After each task, participants were prompted to rate task difficulty, motivation to succeed, tiredness, and energy levels on a 7-point scale from *strongly agree* to *strongly disagree*. Then, they were given a 5-minute rest period prior to the next task.

Intervention

After completing the Baseline Assessment, participants were randomized to one of two intervention conditions – the yoga group, who had access to the yoga program immediately, or the waitlist group, who could access the program after completing the post-intervention assessment. As part of informed consent, participants agreed that if assigned to the waitlist, they would not start any new yoga, seated meditation, or moving meditation practice. The yoga program was developed and led by the author, who is a Registered Yoga Teacher (RYT-200) who has both completed and facilitated trauma-informed yoga teacher training through Brahmanda School of Yoga. She is a clinical neuropsychology doctoral student, with research and clinical training in evidence-based assessments and interventions for cognitive and mental health concerns, including trauma-related changes.

The yoga program is detailed in Chapter 3. In brief, TIME yoga is a four-week intervention, consisting of two weekly 60- to 75- minute sessions. The program was adapted

during the pandemic, such that sessions were taught online in an asynchronous and pre-recorded format. Participants accessed each week's sessions on YouTube via private URLs. They were sent weekly check-in emails, and received a reply to their check-in responses that acknowledged and validated their response (e.g., "That's great news that you found the breathing techniques enjoyable this week"; "It sounds like it has been a stressful week for you"). If participants missed a session, they were able to choose whether to attempt the standard two-session schedule the following week or to additionally attempt the missed session.

Post-Intervention Assessment

After the four-week intervention period, participants were emailed URLs to complete the same cognitive testing procedures and similar questionnaires as outlined in the Baseline Assessment, with the addition of the recent experiences questionnaire. Approximately one month post-yoga program, participants received an email inquiring if they had feedback or reflections about the yoga program, or had noticed any impact of their yoga practice on their life lately.

Data Analytic Strategy

Statistical Processing Software

SPSS Version 26 was used for data management and analyses.

Calculation of ACE Burden

ACE burden scores were calculated separately for: (1) young childhood, (2) school age, (3) adolescence, and (4) across developmental stages, resulting in four ACE burden scores for each participant. The scores range from 0 to 7, and they reflect participants' experiences across the categories of childhood maltreatment and household dysfunction, which are the two factors most commonly included in ACE measurement (e.g., Felitti, 1998; Karatekin & Hill, 2018). As portrayed in Table 1.03, seven domains on the TAQ map onto the two categories of childhood

maltreatment and household dysfunction. The questionnaire items corresponding to each TAQ domain are also listed in Table 1.03. For each domain, participants were given a score of 1 if they endorsed at least one item within the domain; a score of 0 was assigned if participants responded "Never or Not at all" or "Don't Know" to all of the items within the domain.

Table 1.03

ACE Categories with Corresponding TAQ Domains and Items

ACE Category	TAQ Domain	TAQ Items
Childhood Maltreatment	Neglect	2. Someone made sure I got up in the morning and went to school.
		6. Somebody in my family had so many problems that there was little left for me.
		7. I felt that nobody cared whether I lived or died.
		21. I spent time out of the house and no one knew where I was.
		27. My caregivers were so into alcohol or drugs that they couldn't take care of me.
	Emotional Abuse	9. My parents confided things in me that made me feel uncomfortable.
		16. In my parents' eyes, nothing I did was ever good enough.
		17. People in my family called me insulting names.
		18. The rules in my family were unclear and inconsistent.
		19. The punishments I received were unfair.
	Physical Abuse	28. I was beaten, kicked, or punched by someone close to me.
		29. I was in a situation in which I was convinced I would be physically injured or lose my life.
		30. Someone outside my family attacked me.
	Sexual Abuse	35. Someone (older) touched me sexually against my wishes or tried to make me touch them.
		36. Someone forced me to have sex against my will.
		37. Someone threatened me with physical harm unless I did something sexual.
		38. I believed that one of my brothers or sisters was sexually molested.
	Witnessing Trauma	20. My parents hurt each other physically when they argued or fought.
		22. People in my family were out of control.
		23. I witnessed physical violence in my family.
		24. Someone in my family got medical attention because of violence.
		31. I saw dead bodies.
		34. I saw sexual things that scared me.
Household Dysfunction	Separations	10. My parents were divorced or separated.
		11. I lived with different people at different times (like different relatives or foster families).
		12. Somebody close to me died.
		14. Someone I was close to was very sick, or in an accident for which they needed to be hospitalized.
	Alcohol and Drugs	25. Someone in my family had a problem with alcohol and/or drugs.
		26. I abused alcohol and/or drugs.

Missing Data

Missing questionnaire item scores were estimated using within-person mean imputation – that is, for each participant, missing values were replaced with the mean of that participant's scores on other items within the scale or subscale. One participant had one missing item on the baseline PHQ-9. For the baseline PTGI, one participant missed three items across two subscales. For the post-intervention PTGI, another participant missed two items across two subscales.

Computation of Reaction Time (RT) Mean and Intra-Individual Variability (IIV)

First, implausible outliers were removed. Extremely fast responses, with RTs less than 150 msec, were excluded. As cognitive tasks vary in degrees of complexity and required cognitive functions, there was no fixed upper RT boundary that applied to all task or trial types, aside from the maximum time allotted per trial, which was 2000-3000 msec depending on the cognitive task. To address extremely slow responses, for each task and trial type (if applicable), trials with RT values higher than three standard deviations above each individual's mean RT were excluded. Overall, the outlier exclusion process resulted in minimal removal of data; for instance, the baseline data faced removal of 0.02% of N-Back trials, 0.03% of Go/No-Go trials, and 0.02% of congruent trials along with 0.02% of incongruent trials on the Flanker task. Mean RT values were derived after outlier removal.

The across-trial intraindividual standard deviation (ISD) from each individual's mean RT was computed as an index of IIV in RT, using the residuals method as described by Hultsch and colleagues (2008). This involved purifying the data of confounding influences. Multilevel modelling was used to partial the variance related to between-person (i.e., age) and within-person (i.e., time effects as indexed by trial number and its quadratic) factors. After removing the influence of systematic sources of variance, the residuals from this model represented the portion

of performance related to unsystematic factors. The residuals were converted to standardized *T* scores, with $M = 50$ and $SD = 10$, in order to aid interpretation and comparison of performance across tasks. Finally, the standard deviation was calculated for each individual's performance, according to trial type if applicable, on each of the cognitive tasks.

Chapter 2: Exploring the psychological and cognitive functioning of childhood trauma survivors during the COVID-19 crisis

Abstract

A trauma-informed response to the COVID-19 pandemic involves identifying how specific populations are affected by the crisis, in terms of psychological and cognitive functioning. This study examines the functioning of adults with histories of complex childhood trauma (CCT) during the pandemic. Further, it identifies unique risk posed by trauma exposure at specific developmental stages (i.e., young childhood, school-age, or adolescence). In this cross-sectional study, 26 community-dwelling adults with self-identified CCT exposure completed objective cognitive tasks and self-report measures of mental health, emotional functioning, cognition, resilience, and post-traumatic growth. The sample's scores are presented descriptively, in order to depict current functioning during the pandemic, and to facilitate comparisons with other community and psychiatric samples in the literature. Multiple regression analyses evaluated whether adverse childhood experiences (ACEs) at any one developmental stage were more predictive of current functioning versus other stages. Clinically significant mental health symptoms were prevalent in this community sample, and levels of alexithymia and interoceptive awareness were comparable to other psychiatric trauma-exposed samples. Adolescent ACEs were particularly predictive of post-traumatic stress and depressive symptoms as well as poorer interoceptive awareness. Unexpectedly, young childhood ACEs were particularly predictive of greater resilience. These findings add developmental nuance to the literature on CCT. Results are discussed from a neuropsychological lens and are contextualized in the ongoing pandemic. Limitations and future directions are discussed for measuring and examining the neurodevelopmental impact of trauma.

Introduction

The world is currently in a state of medical crisis, spurred by the initial observation of the SARS-CoV-2 coronavirus disease in late 2019 (COVID-19) in Wuhan, China (Huang et al., 2020). Along with the physical symptoms, financial burden, and death toll of the pandemic, there is a rising incidence of new and exacerbated mental health symptoms, both as a direct complication of COVID-19 infection, and by virtue of living during the global crisis (Vindegaard & Benros, 2020). In the present study, *complex childhood trauma (CCT) survivors* refers to adults who carry experiences of trauma within their childhood caregiving system, or *adverse childhood experiences (ACEs),* such as: physical, sexual, or emotional abuse; neglect; separation from caregivers; and witnessing violence, substance abuse, or severe psychopathology in the home. Though the evidence for mental health consequences of COVID-19 is in its infancy, preliminary evidence for worse outcomes among childhood trauma survivors is emerging in the literature (Pressley & Spinazzola, 2020), including depressive tendencies (Kim et al., 2020) and poor sleep among Indigenous Americans (John-Henderson, 2020). Understanding the mental health effects of childhood adversity – and the potential mechanisms by which those effects occur – can help us predict the types of mental health challenges that might be exacerbated by living through a global pandemic such as COVID-19.

Mental Health Among CCT Survivors

Terminology regarding the mental health effects of CCT have evolved over time, first captured in the DSM by Disorders of Extreme Stress, Not Otherwise Specified (DESNOS; Luxenberg et al., 2001), and subsequently referred to in the ICD-11 as Complex PTSD. These diagnoses pertain to trauma exposure at any life stage, and describe disturbances in affect regulation, attention or consciousness, self-perception, interpersonal relationships, somatization,

and systems of meaning. Developmental Trauma Disorder was proposed by van der Kolk et al. (2009) pertaining to trauma responses specifically among children and adolescents. CCT is robustly associated with comorbid depression, anxiety, and attentional issues, as well as suicidality, substance abuse, obesity, cardiovascular and other physical illnesses, and a host of risk-taking behaviours (Felitti et al., 1998; Afifi et al., 2014). Research suggests differential mental health outcomes according to the specific timing of trauma exposure. Earlier exposure to adversity seems to result in more maladaptive outcomes, including prenatal maternal PTSD and depressive symptoms (Atzl et al., 2019), greater PTSD severity (Ogle et al., 2013), greater frequency of PTSD and depression (Dunn et al., 2017), and increased likelihood of incarceration, smoking, and depressive symptoms in primarily African American adults (Giovanelli, 2018). Perry and Winfrey (2021) attest to the harsh impact of trauma during early childhood, when children are neurobiologically sensitive to forging attachment bonds (e.g., Opendak & Sullivan, 2019), are reliant on caregivers to meet their basic needs, cannot verbally describe and comprehend their experience, and are forming somatosensory memories of affect and adversity.

Childhood and adolescence are times of great change neurobiologically, cognitively, and emotionally. Several variables have been proposed to explain the connections between early life adversity and adult mental health outcomes; these shall be explored in the subsequent sections.

Early and Later-Life Stress

Early life experiences are anticipated to impact one's response to pandemic-related stressors. Stress inoculation is a developmental learning process by which coping with mild early life stress bolsters one's resilience to future adversity, as evidenced among monkeys by white matter increases in the ventromedial prefrontal cortex; myelination typically increases linearly throughout childhood and adolescence in this prefrontal area that is implicated in regulating

physiological and emotional responses (Katz et al., 2009). Brosschot and colleagus (2017) posit a similar mechanism of stress "immunization", that is mediated by medial prefrontal cortical inhibition of sympathetic arousal, and occurs when experiencing controllable stressors during early life and adolescence can "immunize" against future uncontrollable situations. However, among humans, heightened sensitivity to stress following chronic childhood stressors is more consistently reported than is inoculation. According to the generalized unsafety theory of stress (GUTS), chronic and unpredictable early life stress prevents the brain from learning how to interpret safety cues, and this leads to deficient prefrontal inhibition of the "default stress response" and concurrently lowered heart-rate variability throughout later life (Brosschot et al., 2017). Repeated activation of fear memories is also thought to contribute to stress vulnerability via the behavioural and neurological processes of stress sensitization, fear conditioning, limbic kindling, and allostatic load (i.e., general wearing down of the body; McFarlane, 2010; McFarlane, 2019; McLaughlin et al., 2010). Neurophysiological substrates of these processes include reduction in hippocampal and amygdalar volumes (Weissman et al., 2020), heightened amygdalar reactivity, dysfunctional hypothalamic-pituitary-adrenal axis activity (McFarlane, 2010), and increased inflammatory responses to daily stressors (Gouin et al., 2012). Behaviorally, even among healthy survivors of early life trauma, mental and physical illnesses often emerge after minor and cumulative stressors as well as major events or traumas (e.g., Shapiro, 2012). Survivors seem to have a lower threshold at which stressors evoke psychopathology, particularly depression (Hammen et al., 2000; Harkness et al., 2006; McLaughlin et al., 2010; Weissman et al., 2020), and also post-traumatic stress disorder (PTSD) and anxiety disorders (McLaughlin et al., 2010; Bandoli et al., 2017; Asselman et al., 2018). A gap in the literature pertains to the impact of specific timing of adversity relative to cognitive and

emotional impacts (Leneman & Gunnar, 2018). While animal studies indicate stress sensitivity at prenatal, infancy, and adolescent stages (e.g., Gee & Casey, 2015), human studies have focused on prenatal, infancy, and early childhood, neglecting later stages of childhood and adolescence.

Executive Functioning and Emotion Regulation

CCT has a dose-response relationship with adulthood challenges in mental and physical health and different aspects of cognitive ability, specifically executive functions (Afifi et al., 2014; Felitti et al., 1998; Cross et al., 2017; Hughes et al., 2017). Executive functions (EF) are broadly classified as a set of interrelated processes supported primarily by the prefrontal cortex that enable one to inhibit, update, and shift awareness to internal and external events in order to behave flexibly, appropriately, and in line with one's goals (Miyake et al., 2000). Though the evidence relies heavily on animal models, the prefrontal cortex has a clear critical period during adolescence (e.g., Larsen & Luna, 2018), when neurogenesis, myelination, and synaptic pruning are highly susceptible to adversity. Thus, for CCT survivors, whereas hippocampal gray matter volume is lessened by childhood abuse, frontal cortical gray matter volume is compromised by adolescent abuse (Andersen et al., 2008). Unfortunately, EF are understudied in the context of CCT, relative to adult-onset PTSD. Trauma-exposed children generally perform worse than controls across cognitive domains and regardless of PTSD status (Malarbi et al., 2017). For EF specifically, an association was reported between childhood trauma severity and self-reported executive dysfunction, mediated by functional connectivity between regions responsible for cognitive and sensorimotor control (S. Silveira et al., 2020). Further, healthy young adults with childhood trauma histories have demonstrated deficits on standardized neuropsychological EF tasks in conjunction with decreased default mode network connectivity in the left ventromedial prefrontal cortex, left orbitofrontal cortex, and right cerebellum (Lu et al., 2017).

Emotion regulation is highly related to EF, such that prefrontal processes enable focused attention on specific emotions, monitoring and shifting of coping strategies, and inhibition of emotional responses that are not adaptive in a given situation (Cross et al., 2017). Emotion dysregulation is a hallmark symptom cluster of Complex PTSD, and is a transdiagnostic feature of various forms of psychopathology (Werner & Gross, 2010). Trauma within the caregiving relationship deprives children of models for labeling, expressing, accepting, and regulating emotions (i.e., monitoring, evaluating, and modifying one's cognitive, behavioural, and physiological emotional responses according to one's goals and environment; Gross & Thompson, 2007). The abilities to differentiate, express, and understand antecedents and consequences of emotions develop in tandem with cognition, across stages of infancy, preschool, school-age, and adolescence (e.g., Zeman et al., 2006). Therefore, emotion dysregulation has been linked with initial maltreatment in middle childhood (Dunn et al., 2018), likely due to development of emotion coping strategies at this time (e.g., Fields & Prinz, 1997).

Intra-Individual Variability in Cognition

The impact of CCT on neuropsychological scores is understudied (K. Silveira et al., 2020), and some studies have failed to find an association between childhood trauma and objective EF performance in healthy adults (e.g., Majer et al., 2010). K. Silveira and colleagues (2020) systematically reviewed clinically-detected neuropsychological impairments in persons with current mental illness and various forms of trauma exposure. Trauma survivors often present with subjective cognitive complaints and statistical differences on experimental tasks, yet are not clinically impaired on standardized neuropsychological tests. The authors suggest that trauma-related cognitive dysfunction may be related to emotion dysregulation and acute traumatic stress reactions, and consequently recommend assessment of reaction time

intraindividual variability (RT-IIV) as a marker of cognitive processes that is perhaps more sensitive than standardized neuropsychological test results. RT-IIV refers to within-person variability in response times across trials in a cognitive task, which is thought to reflect attentional lapses related to EF fluctuations (Strauss et al., 2007; West et al., 2002) and emotion regulation (Ode et al., 2011). RT-IIV is a behavioural index of compromised neural integrity (MacDonald et al., 2006), including alterations in global white matter volume (Jackson et al., 2012) and structure and function of frontal regions in particular, including white matter lesions and dopaminergic activity (Bunce et al., 2010; Lövden et al., 2013; MacDonald et al., 2012). Clinically, RT-IIV is an indicator of neurological conditions such as mild traumatic brain injury and mild cognitive impairment (MacDonald et al., 2006; Merrit et al., 2018; Strauss et al., 2007), as well as neuropsychiatric disorders such as schizophrenia, depression, borderline personality disorder (Kaiser et al., 2008) and PTSD (Swick et al., 2013). Moreover, higher levels of ACEs have been associated with increased RT-IIV on the N-Back working memory task, in HIV+ adults (Clark et al., 2018). This variability was strongly associated with total volume reductions, and unrelated to PTSD, depression, or stress.

Interoceptive Awareness and Alexithymia

Interoceptive awareness is the conscious detection of the physiological condition of one's body, including one's emotional state (Craig, 2002); its core mechanistic role in CCT-related mental illnesses, including PTSD, is becoming increasingly recognized, and thus it is targeted by emerging somatic treatments for complex trauma, including yoga (e.g., Neukirch et al., 2019) and somatic experiencing (e.g., Payne et al., 2015). Neuroimaging evidence suggests that lower-level somatosensory information is coded in the posterior insula and subsequently linked with executive control and affective networks in the anterior insula. Neurodevelopmentally, among

children and adolescents, age has been associated with increased activation in the dorsal anterior insula (Li et al., 2017), as well as in the anterior cingulate cortex, orbito-frontal cortex, and left prefrontal cortex (Klabunde et al., 2019) during emotion and interoceptive processing tasks. Altogether, the recent literature suggests that interoceptive awareness develops in parallel with EF and matures in adolescence (Li et al., 2017; Crone & Dahl, 2012).

Awareness of interoceptive experiences is closely related to the construct of alexithymia – the ability to identify and verbalize emotions, a feature of emotion regulation that is broadly related to psychopathology (Grabe et al., 2004). Developmental research on alexithymia is sparse. Perhaps adverse parenting interactions during younger childhood are a pertinent predictor of alexithymia, as parenting styles (Kooiman et al., 2004) and neglect (Zlotnick et al., 2001) are associated with this trait, and as children typically learn to label emotions via the caregiver dyad during toddlerhood (Zeman et al., 2006). One study suggests that alexithymia remains a stable personality trait through adolescence (Karukivi et al., 2014), with permeability to support from friends but not from parents at this later stage.

Post-Traumatic Growth and Resilience After CCT

Although CCT and ACEs serve as risk factors, they are not rigidly deterministic. Resilience is commonly defined as the ability to bounce back or recover from stress (Smith et al., 2008), and may mitigate the impacts of CCT and ACEs on later functioning. An integrative view of resilience does not preclude developing psychopathological symptoms in response to adversity (Southwick et al., 2014). Rather, resilience is depicted as the active decision-making and ability to move forward each day in a positive manner that integrates one's struggles with lessons learned. Post-traumatic growth (PTG) is a related yet distinct construct, referring to a positive change as a direct result of crisis (Tedeschi & Calhoun, 2004). This growth can manifest

in many domains, including greater appreciation for life, more meaningful relationships, an increased sense of personal strength, reorganized priorities, and enriched existential or spiritual beliefs. While resilience can imply returning to pre-trauma levels of coping, PTG involves a qualitative transformation that occurs when one is challenged by trauma and is pushed to move beyond pre-trauma ways of living. Simultaneous experiences of PTG and distress are documented among CCT survivors (e.g., Barakat et al., 2006; Hartley et al., 2016; Kaye-Tzadok & Davidson-Arad, 2016), and there is even debate as to whether post-traumatic stress is a prerequisite for growth (e.g., Klosky et al., 2014).

Psychophysiological predictors of resilience have been examined among healthy adults; resilience was most strongly (negatively) predicted by childhood trauma, and was also positively correlated with secure attachment (Simeon et al., 2007). For CCT survivors, various factors are known to contribute to later-life PTG, including attachment style, mental health symptomology, sense of life threat, and sociodemographic factors (e.g., Barakat et al., 2006; Kaye-Tzadok & Davidson-Arad, 2016; Lev-Wiesel & Amir, 2003; Nelson et al., 2019). There is scarce documentation of resilience and PTG among CCT survivors following a later-life crisis, such as the COVID-19 pandemic. Hyun and colleagues (2021) recently studied growth-oriented outcomes among young adults as a result of pandemic-related life disruptions. Low levels of PTG in this group were attributed to study timing; the enormity of the pandemic may not be realized early-on, and growth may not occur until after the pandemic has ceased. Consistent with the broader PTG literature, PTSD symptoms and COVID-19 worry predicted higher PTG, while depressive symptoms predicted lower levels. After controlling these factors, resilience and family connectedness predicted higher PTG, and distress tolerance predicted lower PTG. These findings highlight the relevance of distress tolerance and family connectedness to pandemic-

related PTG. Low distress tolerance is a core symptom of complex trauma, and thus individuals with higher ACE scores may experience the pandemic as a distressing event from which to grow. Further, individuals with more recent ACEs during adolescence, may experience less familial support to assist with coping with distress and bolstering growth.

Current Study

The current study is an exploratory investigation of CCT survivors' functioning during the COVID-19 pandemic. The study aimed to: (1) describe survivors' current psychological and cognitive functioning (i.e., mental health, emotion regulation, interoceptive awareness, alexithymia, resilience, PTG, and EF); and (2) evaluate whether ACEs during any particular developmental stage (i.e., young childhood, school age, or adolescence) are uniquely predictive of adults' current psychological and cognitive functioning, relative to ACEs during other stages. It was hypothesized that: young childhood trauma in particular, would predict poorer mental health, resilience to stress, and alexithymia; middle childhood trauma would predict emotion dysregulation; and adolescent trauma would be associated with poorer interoceptive awareness, self-reported EF, IIV on objective EF tasks, and PTG.

Methods

The methods for this study are outlined in Chapter 1. Statistical methods pertinent to the current study are outlined below.

Regression Analyses

A series of multiple linear regressions were calculated. ACE scores for each of three developmental stages (i.e., young childhood, school age, and adolescence) were predictors, along with the covariate of age. Key assumptions of multiple regression were met, including those pertaining to linear relationships, multivariate normality, multicollinearity, and homoscedasticity.

For the resilience outcome in particular, given its potential curvilinear relationship with ACEs, scatterplots were examined, and no curvilinear associations were evident.

Selection of Outcome Variables

In order to contain the number of analyses and Type I error rate, total rather than subscale scores were selected for self-report questionnaire outcomes. Further, composite variables were created for certain outcome measures, based on theoretical and statistical associations among measures. Specifically, the utility of composite variables was explored for combining measures of mental health (i.e., PCL-5, PHQ-9, GAD-7), interoceptive awareness (i.e., the six MAIA scales comprising the "general MAIA factor", as described by Ferentzi et al., 2020), self-reported EF (i.e., ACS and EFI), and cognitive IIV (i.e., ISD on the Flanker, N-back, and Go/No-Go tasks). Following simple averaging procedures outlined by Song and colleagues (2013) for creating composite variables, for each set of outcome measures specified above, correlation matrices were examined for significant correlations ($p < .05$) among outcome measures (i.e., typically a moderate or large correlation) and similar associations between each outcome measure and ACE predictors. Based on these criteria, three composite variables were statistically viable: (1) a post-traumatic stress and depression composite comprised of PCL-5 and PHQ-9 scores. GAD-7 scores were analyzed separately from the composite; (2) an interoceptive awareness composite of five MAIA scales from the general MAIA factor (i.e., Noticing, Emotional Awareness, Body Listening, Attention Regulation, and Self-Regulation; Trusting was not significantly correlated with the other five scales in the general MAIA factor in this sample, despite prior research findings, and thus was not included in the composite); and (3) a self-reported EF composite comprised of ACS and EFI total scores. Cognitive IIV did not meet composite criteria and thus was analyzed separately for each of the cognitive tasks. Composite

variables were created by summing *Z* scores for individual measures, and then converting the summed score to *T* scores for ease of interpretability.

Given the exploratory nature of this study, analyses of composite variables resulting in *p* values between .05 and .10 were considered to show possible trends warranting further investigation (e.g., Schumm et al., 2013). In order to evaluate whether specific outcome measures might be driving the observed trends, secondary analyses of the individual variables comprising the composite were conducted, using Benjamini-Hochberg's (1995) procedure to control the false discovery rate (FDR). An FDR of .15 was selected *a priori*, in order to balance risks of type I and II errors within a small-sample exploratory study, as discussed by McDonald (2014).

Results

Descriptive Statistics

Baseline self-report and cognitive task scores (N = 26) are presented in Table 2.01.

Table 2.01

Descriptive Statistics for Baseline Self-Report and Objective Measures

Measure	*M*	*SD*	Range (Possible range)	Clinical Interpretation[a]
PCL-5	26.23	12.59	8 – 48 (0 – 80)	Below PTSD threshold
PHQ-9	10.50	5.25	2 – 21 (0 – 27)	Moderate depression
GAD-7	8.77	4.50	2 – 20 (0 -21)	Mild anxiety
ACS	50.04	10.15	30 – 65 (20 – 80)	
EFI				
Empathy	26.65	3.81	14 – 30 (6 – 30)	
Strategic Planning	26.35	4.42	15 – 32 (7 – 35)	
Organization	17.27	4.55	8 – 24 (5 – 25)	
Impulse Control	17.81	3.48	8 – 24 (5 – 25)	
Motivational Drive (Revised)	11.15	2.22	7 – 15 (3 – 15)	
Total	102.23	13.32	73 – 122 (27 – 135)	

ERQ				
Reappraisal	4.94	1.08	2.67 – 7.00 (1 – 7)	
Suppression	3.51	1.40	1.25 – 6.75 (1 – 7)	
Total	4.37	0.72	3.20 – 6.50 (1 – 7)	
TAS-20				
Difficulty Describing Feelings	18.42	5.61	7 – 28 (7 – 35)	
Difficulty Identifying feelings	14.27	4.36	5 – 21 (5 – 25)	
Externally-Oriented Thinking	18.77	5.10	11 – 28 (8 – 40)	
Total	51.46	12.81	26 – 75 (20 – 100)	Non-alexithymia
MAIA				
Noticing	3.14	1.10	0.50 – 5.00 (0 – 5)	
Non-Distracting (Revised)	2.25	1.21	0.00 – 5.00 (0 – 5)	
Attention Regulation	2.73	1.01	1.00 – 4.86 (0 – 5)	
Emotional Awareness	3.15	1.31	0.40 – 5.00 (0 – 5)	
Self-Regulation	2.74	1.14	1.00 – 5.00 (0 – 5)	
Body Listening	2.08	1.47	0.00 – 5.00 (0 – 5)	
Trusting	3.13	1.16	0.67 – 5.00 (0 – 5)	
BRS	3.23	0.75	2.00 – 4.83 (1 – 5)	
PTGI				
New Possibilities	9.21	6.64	0 – 25 (0 – 25)	
Relating to Others	11.05	8.95	0 – 31 (0 – 35)	
Personal Strength	7.39	5.51	0 – 20 (0 – 20)	
Spiritual Change	1.19	2.00	0 – 6 (0 – 10)	
Appreciation of Life	5.88	4.07	0 – 14 (0 – 15)	
Total	34.72	23.70	0 – 90 (21 – 105)	
N-Back Task				
Accuracy[b]	.74	.17	.08 - .95	
RT	679.92	168.63	431.66 – 1182.10	
IIV	9.44	5.07	3.79 – 29.30	
Go/No-Go Task				
Accuracy[b]	.91	.06	.74 – 1.00	
RT	369.85	61.08	290.29 – 508.23	
IIV	9.35	3.75	4.27 – 19.47	
Flanker Task				
Congruent Trials – Proportion Errors	.05	.06	.00 - .25	

Congruent Trials – RT	693.22	135.38	509.95 – 1238.19
Congruent Trials – IIV	9.70	3.28	4.47 – 19.07
Incongruent Trials – Proportion Errors	.07	.05	.02 - .22
Incongruent Trials – RT	730.00	143.23	522.28 – 1271.94
Incongruent Trials – IIV	9.67	3.25	4.16 – 19.71

[a] Interpretation of *M* scores [b] Matthew's correlation coefficient

Clinical Significance of Scores

Depression was the most common mental health concern in the sample; 65.4% of participants scored 10 or higher on the PHQ-9, which indicates clinically significant symptoms of depression. 42.3% of participants scored 10 or higher on the GAD-7, meeting criteria for clinically significant generalized anxiety symptoms. 38.5% of participants scored 33 or higher on the PCL-5, which demonstrates clinically significant PTSD symptoms. On the TAS-20, 57.7% of participants met criteria for possible alexithymia, and 15.4% of participants met criteria for a clinical designation of alexithymia.

ACE Burden

ACE type endorsement is outlined in Table 2.02. Total ACE burden across developmental stages ranged from 2 to 7 (*M* = 5.85; *SD* = 1.38). ACE burden ranged from 0 to 7 within each developmental period, and increased with age, from young childhood (*M* = 3.08; *SD* = 1.96) to school age (*M* = 4.46; *SD* = 1.70) and adolescence (*M* = 4.92; *SD* = 1.67). Missing or "don't know" responses were most common for young childhood.

Table 2.02

Percentage of Participants Endorsing ACEs Across and Within Developmental Stages

ACE Type	Across Developmental Stages: 0 – 18 years	Young Child: 0 – 6 years *(Missing or "Don't Know" Responses)*[1]	School Age: 7 – 12 years *(Missing or "Don't Know" Responses)*[1]	Adolescent: 13 – 18 years *(Missing or "Don't Know" Responses)*[1]
Separations	96.15%	53.85%	73.08%	84.62

		(15.38%)	*(7.69%)*	*(11.54%)*
Neglect	92.31%	65.38% *(23.08%)*	84.61% *(3.85%)*	92.31% *(3.85%)*
Witnessing Trauma	92.31%	46.15% *(23.08%)*	76.92% *(3.85%)*	80.77% *(3.85%)*
Emotional Abuse	92.31%	53.85% *(34.62%)*	80.77% *(7.69%)*	92.31% *(7.69%)*
Physical Abuse	84.62%	42.31% *(11.54%)*	57.69% *(11.54%)*	30.77% *(7.69%)*
Substance Use Exposure	69.23%	30.77% *(15.38%)*	46.15% *(0%)*	65.38% *(0%)*
Sexual Abuse	57.69%	15.38% *(15.38%)*	26.92% *(11.54%)*	46.15% *(7.69%)*

[1]Percentage of participants with missing or "don't know" responses on at least one Traumatic Antecedents Questionnaire item within the corresponding ACE domain

Life Events

Events endorsed on the LEC are organized in order of frequency of direct experience, in Table 2.03. Participants' descriptions of their "worst" or most currently bothersome events, fell under the following categories: intimate partner violence (15.6%); verbal abuse (7.6%); sexual abuse (7.6%); combat trauma (7.6%); family member's cancer diagnosis or treatment (7.6%); mental illness of intimate partner or friend (7.6%); parental substance abuse (3.8%); parental death (3.8%); physical abuse (3.8%); neglect (3.8%); emotional abuse (3.8%); unwanted or uncomfortable sexual experience (3.8%); and serious accident (3.8%). 19.2% of participants did not report a worst event. 69.6% of participants indicated that their worst event occurred when they were 18 years or younger (i.e., during childhood or adolescence).

Table 2.03

Percentage of Event Endorsement on the LEC by Nature of Experience

Life Event	Nature of Experience					
	Happened to Me	Witnessed it	Learned About it	Part of My Job	Not Sure	Doesn't Apply

Other Unwanted or Uncomfortable Sexual Experience	53.8%	15.4%	34.6%	15.4%	0%	26.9%
Transportation Accident	53.8%	34.6%	30.8%	11.5%	0%	34.6%
Physical Assault	50.0%	30.8%	23.1%	15.4%	0%	38.5%
Sexual Assault	34.6%	15.4%	57.7%	15.4%	3.8%	30.8%
Other Very Stressful Experience	26.9%	19.2%	7.7%	3.8%	0%	0%
Natural Disaster	23.1%	23.1%	34.6%	11.5%	3.8%	65.4%
Severe Human Suffering	15.4%	30.8%	30.8%	15.4%	7.7%	42.3%
Serious Accident	11.5%	23.1%	30.8%	11.5%	0%	57.7%
Assault with Weapon	11.5%	7.7%	30.8%	11.5%	0%	57.7%
Life-Threatening Illness or Injury	11.5%	46.2%	46.2%	15.4%	0%	34.6%
Fire or Explosion	11.5%	19.2%	30.8%	11.5%	0%	61.5%
Sudden Violent Death	7.7%	15.4%	38.5%	15.4%	0%	53.8%
Combat or Exposure to War-Zone	7.7%	7.7%	26.9%	7.7%	0%	76.9%
Sudden Accidental Death	3.8%	23.1%	50.0%	15.4%	0%	46.2%
Exposure to Toxic Substance	3.8%	11.5%	23.1%	11.5%	7.7%	65.4%
Captivity	0%	0%	15.4%	3.8%	3.8%	76.9%
Caused Serious Injury, Harm, or Death to Someone Else	0%	3.8%	0%	3.8%	0%	92.3%

Experiences During Cognitive Testing

Perceived task difficulty, motivation, tiredness, and energy are reported below. For each variable, the possible range is 1 to 7, with higher scores indicating higher levels.

Task Difficulty. Participants' mean difficulty ratings were: 3.92 (*SD* = 1.81; range = 1-7) for Flanker, 5.04 (*SD* = 1.56; range = 1-7) for N-back, and 3.35 (*SD* = 1.79; range = 1-6) for Go/No-Go. As measured by Friedman's ANOVA, perceived task difficulty significantly differed between the three tasks, $\chi^2(2) = 15.77$, $p < .001$. Post-hoc tests with Wilcoxon Signed Ranks indicated that N-back difficulty was significantly higher than both Go/No-Go difficulty (z = -

3.10, p = .001) and Flanker difficulty (z = -2.93, p = .003), while Go/No-Go and Flanker difficulty did not significantly differ (z = -1.72, p = .085).

Motivation. Participants' mean level of motivation was 5.46 (*SD* = 1.50; range = 2-7) for Flanker, 4.88 (*SD* = 1.75; range = 1-7) for N-back, and 5.77 (*SD* = 1.27; range = 2-7) for Go/No-Go. Motivation did not differ between tasks, $\chi^2(2) = 3.56$, p = .169.

Tiredness. Mean tiredness levels were: 4.54 (*SD* = 1.63; range = 2-7) for Flanker, 5.27 (*SD* = 1.12; range = 3-7) for N-back, and 3.62 (*SD* = 1.65; range = 1-7) for Go/No-Go. Tiredness significantly differed between the tasks, $\chi^2(2) = 12.65$, p = .002. Post-hoc tests indicated that tiredness during N-back was significantly greater in comparison to Go/No-Go (z = -3.43 p = .001) and Flanker *(*z = -2.30, p = .022), and tiredness during Flanker was significantly greater than during Go/No-Go (z = -2.02, p = .044).

Energy. Participants reported mean energy levels of 3.42 (*SD* = 1.55; range = 1-6) for Flanker, 2.96 (*SD* = 1.53; range = 1-6) for N-back, and 4.31 (*SD* = 1.49; range = 2-7) for Go/No-Go. Differences in energy levels between tasks were trending towards significance, $\chi^2(2) = 5.77$, p = .056. Post-hoc analyses indicated that energy during Go/No-Go was significantly higher relative to energy during Flanker (z = -2.07, p = .038), and N-back (z = -2.65, p = .008), while Flanker and N-back did not significantly differ (z = -1.52, p = .129).

Regression Analyses

Association between ACEs and Mental Health

Two multiple linear regressions were calculated to predict the post-traumatic stress and depressive composite and GAD-7 scores (see Tables 2.04 and 2.05). For the composite, a non-significant regression equation was found (F (4, 21) = 1.96, p = .138), with an R^2 of .27. ACE burden during adolescence was the only significant predictor in this model (t (21) = 2.43, p =

.024). For GAD-7 scores, the regression equation was non-significant (F (4, 21) = 0.59, p = .677), with an R^2 of .10. No predictors in this model were significant.

Table 2.04

Multiple Regression: ACE Burden and Post-Traumatic Stress and Depressive Symptoms

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
PTSD and Depression (DV)	50	10				
Constant				45.32	7.22	
Age	24.69	8.20	-.18	-.36	.25	-.*30*
ACE Score – Young Childhood	3.08	1.96	.11	.63	1.12	.12
ACE Score – School Age	4.46	1.70	.06	-.94	1.55	-.16
ACE Score – Adolescence	4.92	1.67	.40*	3.21	1.32	0.54

Note: R^2 =.27
**p < .05*

Table 2.05

Multiple Regression: ACE Burden and Generalized Anxiety Symptoms

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
GAD-7 Score (DV)	8.77	4.50				
Constant				8.85	3.61	
Age	24.69	8.20	-.17	-.17	.13	-.30
ACE Score – Young Childhood	3.08	1.96	.05	-.09	.56	-.04
ACE Score – School Age	4.46	1.70	.15	.66	.78	.25
ACE Score – Adolescence	4.92	1.67	.14	.27	.66	.10

Note: R^2 =.10

Associations between ACEs and Cognition

A multiple regression was conducted to analyze the prediction of self-reported EF composite scores (See Table 2.06). The regression equation was non-significant (F (4, 21) = 0.47, p = .756), with an R^2 of .08, and no significant predictors.

Table 2.06

Multiple Regression: ACE Burden and Self-Reported EF

Variable	*M*	*SD*	*r*	*B*	*SE B*	B
Self-Reported EF (DV)	50.00	10.00				
Constant				54.77	8.11	
Age	24.69	8.20	.02	0.12	0.28	0.10
ACE Score – Young Childhood	3.08	1.96	-.22	-1.14	1.26	-0.22
ACE Score – School Age	4.46	1.70	-.12	0.34	1.74	0.06
ACE Score – Adolescence	4.92	1.67	-.20	-1.18	1.48	-0.20

Note: $R^2 = .08$

Three multiple regressions were calculated in order to predict ISD during incongruent Flanker trials, the Go/No-Go task, and the N-Back task (See Tables 2.07 through 2.09). Prior to analyses, one outlier was removed from the N-back data, with an ISD 3.92 *SD*s higher than the mean. The regression equation was non-significant for incongruent Flanker trials (F (4, 21) = 0.64, p = .640), with an $R^2$of .11, and no significant predictors. For ISD on the Go/No-Go task, the regression equation was also non-significant (F (4, 21) = 0.27, p = .892), with an R^2 of .05, and no significant predictors. Finally, for ISD on the N-Back task, there was a non-significant regression equation (F (4, 20) = 0.58, p = .682), with an R^2 of .10, and no significant predictors.

Table 2.07

Multiple Regression: ACE Burden and ISD on Incongruent Flanker Trials

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
ISD (DV)	9.67	3.25				
Constant				8.56	2.59	
Age	24.69	8.20	.02	0.01	0.09	0.03
ACE Score – Young Childhood	3.08	1.96	.21	0.54	0.40	0.32
ACE Score – School Age	4.46	1.70	-.04	-0.65	0.56	-0.34
ACE Score – Adolescence	4.92	1.67	.13	0.42	0.47	0.22

Note: $R^2 = .11$

Table 2.08

Multiple Regression: ACE Burden and ISD on Go/No-Go Task

Variable	*M*	*SD*	*r*	*B*	*SE B*	B
ISD (DV)	9.35	3.75				
Constant				10.70	3.10	
Age	24.69	8.20	-.01	0.00	0.11	0.00
ACE Score – Young Childhood	3.08	1.96	.06	0.14	0.48	0.07
ACE Score – School Age	4.46	1.70	.01	0.22	0.67	0.10
ACE Score – Adolescence	4.92	1.67	-.18	-0.56	0.57	-0.25

Note: $R^2 = .05$

Table 2.09

Multiple Regression: ACE Burden and ISD on N-Back Task

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
ISD (DV)	8.64	3.12				
Constant				11.10	2.52	
Age	24.96	8.25	-.07	0.01	0.09	0.04
ACE Score – Young Childhood	3.04	1.99	.01	0.17	0.39	0.11
ACE Score – School Age	4.48	1.74	-.16	-0.12	0.55	-0.06
ACE Score – Adolescence	4.88	1.69	-.31	-0.57	0.47	-0.31

Note: $R^2 = .10$

Associations between ACEs and Emotional Functioning

Two multiple regressions were calculated to predict ERQ Reappraisal and Suppression scores (See Tables 2.10 and 2.11). A non-significant regression equation was found for Reappraisal (F (4, 21) = 0.60, p = .664), with an R^2 of .10; none of the predictors were significant. A non-significant regression equation was also found for Suppression (F (4, 21) 0.23, p = .922), with an R^2 of .04, and no significant predictors.

Table 2.10

Multiple Regression: ACE Burden and Reappraisal on the ERQ

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
Reappraisal Score (DV)	4.94	1.08				
Constant				5.68	0.87	
Age	24.69	8.20	-.01	0.02	0.03	0.14
ACE Score – Young Childhood	3.08	1.96	-.13	0.01	0.13	0.01
ACE Score – School Age	4.46	1.70	-.27	-0.16	0.19	-0.25
ACE Score – Adolescence	4.92	1.67	-.25	-0.11	0.16	-0.16

Note: $R^2 = .10$

Table 2.11

Multiple Regression: ACE Burden and Suppression on the ERQ

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
Suppression Score (DV)	3.51	1.40				
Constant				2.69	1.16	
Age	24.69	8.20	.11	0.01	0.04	0.03
ACE Score – Young Childhood	3.08	1.96	.15	0.05	0.18	0.07
ACE Score – School Age	4.46	1.70	.19	0.11	0.25	0.14
ACE Score – Adolescence	4.92	1.67	.11	0.01	0.21	0.01

Note: $R^2 = .04$

A multiple regression was calculated to predict the interoceptive awareness composite, as shown in Table 2.12. The regression equation was non-significant (F (4, 21) = 1.15, p = .260), with an R^2 of .18. ACE burden during adolescence was a significant (negative) predictor according to the exploratory guidelines previously described, (t (21) = -1.89, p = .073).

Table 2.12

Multiple Regression: ACE Burden and Interoceptive Awareness

Variable	*M*	*SD*	*r*	*B*	*SE B*	B
Interoceptive Awareness (DV)	50.00	10.00				
Constant				51.85	7.66	
Age	24.69	8.20	.19	.31	.27	.25
ACE Score – Young Childhood	3.08	1.96	-.02	-.24	1.19	-.05

ACE Score – School Age	4.46	1.70	.01	.96	1.65	.16
ACE Score – Adolescence	4.92	1.67	-.29	-2.65	1.40	-.44

Note: R^2 =.18

Secondary analyses of the five MAIA scales composing the interoceptive awareness composite were conducted, as shown in Tables 2.13 through 2.17, using the Benjamini-Hochberg correction procedure (See table of adjusted *p* values in Appendix B). For Self-Regulation, though the regression equation was non-significant (F (4, 21) = 1.99, p = .133), with an R^2 of .28, ACE burden during adolescence significantly (negatively) predicted Self-Regulation scores (t (21) = -2.28, p = .033), Similarly, for Body Listening, there was a non-significant regression equation (F (4, 21) = 1.63, p = .204), with an R^2 of .24, and ACE burden during adolescence was the only marginally significant (negative) predictor (t (21) = -2.08, p = .050). For Noticing, a non-significant regression equation was found (F (4, 21) = 0.47, p = .761), with an R^2 of .08, and none of the predictors were significant. For Attention Regulation, a non-significant regression equation was found (F (4, 21) = 1.05, p = .408), with an R^2 of .17, and no significant predictors. For Emotional Awareness, the regression equation was non-significant (F (4, 21) = 0.72, p = 0.589), with an R^2 of .12, and no significant predictors.

Table 2.13

Multiple Regression: ACE Burden and Self-Regulation on the MAIA

Variable	*M*	*SD*	*r*	*B*	*SE B*	B
Self-Regulation (DV)	2.74	1.14				
Constant				3.01	0.82	
Age	24.69	8.20	.22	0.04	0.03	0.29
ACE Score – Young Childhood	3.08	1.96	-.17	-0.15	0.13	-0.26
ACE Score – School Age	4.46	1.70	.02	0.20	0.18	0.30
ACE Score – Adolescence	4.92	1.67	-.33*	-0.34	0.15	-0.50

Note: R^2 =.28
**p = .05*

Table 2.14

Multiple Regression: ACE Burden and Body Listening on the MAIA

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
Body Listening (DV)	2.08	1.47				
Constant				2.29	1.09	
Age	24.69	8.20	.23	0.06	0.04	0.32
ACE Score – Young Childhood	3.08	1.96	.09	0.09	0.17	0.12
ACE Score – School Age	4.46	1.70	-.02	0.03	0.23	0.03
ACE Score – Adolescence	4.92	1.67	-.33*	-0.41	0.20	-0.47

Note: R^2 =.24
**p = .05*

Table 2.15

Multiple Regression: ACE Burden and Noticing on the MAIA

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
Noticing (DV)	3.14	1.10				
Constant				3.27	0.89	
Age	24.69	8.20	.12	0.02	0.03	0.15
ACE Score – Young Childhood	3.08	1.96	.05	0.02	0.14	0.04
ACE Score – School Age	4.46	1.70	.03	0.07	0.19	0.10
ACE Score – Adolescence	4.92	1.67	-.20	-0.20	0.16	-0.30

Note: R^2 =.08

Table 2.16

Multiple Regression: ACE Burden and Attention Regulation on the MAIA

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
Attention Regulation (DV)	2.73	1.01				
Constant				3.37	0.78	
Age	24.69	8.20	.08	0.03	0.03	0.21
ACE Score – Young Childhood	3.08	1.96	-.18	-0.07	0.12	-0.14
ACE Score – School Age	4.46	1.70	-.17	0.01	0.17	0.01
ACE Score – Adolescence	4.92	1.67	-.34*	-0.22	0.14	-0.37

Note: $R^2 = .17$
*$p < .05$

Table 2.17

Multiple Regression: ACE Burden and Emotional Awareness on the MAIA

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
Emotional Awareness (DV)	3.15	1.31				
Constant				2.74	1.04	
Age	24.69	8.20	.19	0.02	0.04	0.15
ACE Score – Young Childhood	3.08	1.96	.13	0.02	0.16	0.03
ACE Score – School Age	4.46	1.70	.19	0.22	0.22	0.28
ACE Score – Adolescence	4.92	1.67	-.11	-0.24	0.19	-0.31

Note: $R^2 = .12$

A multiple regression equation was calculated to predict TAS total scores (See Table 2.18). A non-significant regression equation was found (F (4, 21) = 1.10, p = .381), with an R^2 of .17, and no significant predictors.

Table 2.18

Multiple Regression: ACE Burden and Alexithymia

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
TAS Score (DV)	51.46	12.81				
Constant				44.17	9.86	
Age	24.69	8.20	-.10	-0.42	0.35	-0.27
ACE Score – Young Childhood	3.08	1.96	.21	0.90	1.53	0.14
ACE Score – School Age	4.46	1.70	.22	0.72	2.12	0.10
ACE Score – Adolescence	4.92	1.67	.32	2.35	1.80	0.31

Note: $R^2 = .17$

Associations of ACEs with Resilience and Post-Traumatic Growth

The prediction of BRS and PTGI scores was examined with two multiple regressions (See Tables 2.19 and 2.20). For BRS scores, the regression equation was non-significant (F (4,

21) = 2.16, p = .109), with an R^2 of .29. ACE Burden during young childhood significantly predicted BRS scores (t (21) = 2.25, p = .036, and the other predictors were non-significant. For PTGI scores, the regression equation was non-significant (F (4, 21) = 0.26, p = .899, with an R^2 of .05, and none of the predictors were significant.

Table 2.19

Multiple Regression: ACE Burden and Resilience

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
BRS Score (DV)	3.23	.75				
Constant				3.57	0.54	
Age	24.69	8.20	.03	0.01	0.02	0.10
ACE Score – Young Childhood	3.08	1.96	.33*	0.19	0.08	0.49
ACE Score – School Age	4.46	1.70	-.05	-0.06	0.12	-0.15
ACE Score – Adolescence	4.92	1.67	.31	-0.17	0.10	-0.39

Note: R^2 =.29
**p < .05*

Table 2.20

Multiple Regression: ACE Burden and Post-Traumatic Growth

Variable	*M*	*SD*	*r*	*B*	*SE B*	β
PTGI Score (DV)	34.72	23.70				
Constant				42.06	19.57	
Age	24.69	8.20	-.03	-0.14	0.69	-0.05
ACE Score – Young Childhood	3.08	1.96	.08	0.83	3.04	0.07
ACE Score – School Age	4.46	1.70	.05	2.15	4.21	0.15
ACE Score – Adolescence	4.92	1.67	-.14	-3.27	3.58	-0.23

Note: R^2 =.05

Discussion

This study explored the psychological and cognitive functioning of adult survivors of CCT, in the context of the COVID-19 pandemic. In brief, survivors had experienced a range of two to seven ACEs in total, with reported adversities incrementally increasing across

developmental stages. The most common ACEs were separations, followed by neglect, witnessing trauma, and emotional abuse. Participants reported various adverse lifetime events, with approximately half of the sample noting unwanted sexual experiences, physical assaults, and transportation accidents. The majority indicated that their worst lifetime event had occurred during childhood. Direct experiences with COVID-19 were relatively low; only one participant was at high-risk for developing severe illness related to the virus, and none of the participants had tested positive for COVID-19 or believed they had the virus, or were hospitalized during the pandemic. A minority of participants had loved ones who tested positive for COVID-19, or who were hospitalized, or who died during the pandemic. Indirect effects of the virus were prevalent; all participants had practiced social distancing, and over half had additionally practiced self-isolation at home. Exactly 50% of participants suffered substantial pandemic-related income loss, and nearly half of these participants had lost their jobs entirely and were struggling to pay basic living expenses. Approximately one third of participants were essential workers. Of note, 80% of participants in the current community sample were undergraduate students, and thus findings may not be generalizable to other true community samples.

Psychological and Cognitive Functioning

Many participants from this community sample endorsed clinically significant recent symptoms of depression (65%), generalized anxiety (42%), and PTSD (39%). While the current study lacked any comparison groups, the sample's scores on certain measures of emotional functioning were comparable to other trauma-exposed and psychiatric samples. For instance, mean alexithymia scores were relatively high, falling between mean levels reported in Bagby and colleagues' (1994) undergraduate and outpatient psychiatric validation samples, and between levels noted in psychiatric inpatients with trauma exposure and those with trauma exposure plus

PTSD (Spitzer et al., 2007). In a community sample, alexithymia was more likely to develop in adults who had suffered emotional neglect – which was prominent among the current study participants – relative to those who had survived physical and sexual abuse (Aust et al., 2013). Emotional neglect deprives children of interactions with caregivers that promote identification and communication of emotions. Individuals belonging to this "neglect type" of alexithymia also struggle with other aspects of affective functioning, relative to the "non-neglect" type of alexithymia that is attributed to genetic or neural abnormalities more so than experience (Aust et al., 2013). Along this line, interoceptive awareness was markedly lower in the current sample, in comparison to Mehling and colleagues' (2012) study of students and instructors of mind-body practices; approximately half of the current sample had tried moving and seated meditations, with a minority having sustained a regular practice in the past, and none having a current regular practice. The current sample's scores were more comparable to a sample of participants with PTSD enrolled in a Trauma-Sensitive Yoga program (Neukirch et al., 2019), who reported similar baseline scores of self-regulation and body listening, and attention regulation scores approximately 1.5 *SD*s lower than the current sample. Finally, emotion regulation scores (i.e., suppression and reappraisal strategies) were consistent with Gross and John's (2003) undergraduate validation sample, which may indeed have consisted of ACE-exposed students. Taken together, the current sample's emotional profile is interesting in that alexithymia and interoceptive awareness, rather than emotion regulation strategies, were more reflective of childhood adversity and post-traumatic and affective symptoms. This profile may also reflect pandemic-related emotional and physical disruptions, including heightened fear, confusion, or distrust in relation to bodily sensations that could signal COVID-19 infection, as well as difficulty decoding unprecedented emotional responses to the novel health crisis.

Regarding self-reported cognition, attentional control was on par with undergraduate validation samples (Judah et al., 2014). Self-reported EF in the current predominantly college-educated sample, was somewhat higher relative to Spinella and colleagues' (2005) community sample, perhaps due to the known associations between EF and academic achievement (Huizinga et al., 2018) and the natural selection process of post-secondary admittance and retention.

In line with Southwick and colleagues' (2014) commentary that the standard definition of resilience (i.e., bouncing back to baseline) does not entirely capture the impact of trauma, resilience scores in the current sample were similar to a student sample (e.g., Smith et al., 2008). Post-traumatic growth, however, was notably low, falling nearly 2 *SD*s below Tedeschi and Calhoun's (1996) original sample of female undergraduates endorsing a significant negative life event during the past five years. This is similar to Hyun and colleagues' (2021) report of low levels of PTG in the midst of the ongoing COVID-19 pandemic, during which the traumatic impact may not yet be realized, or may be in an acute phase that is premature for transformation. Further, given that family connectedness predicted PTG (Hyun et al., 2021), it follows that PTG was low in the current sample of adults with ACEs and presumably, experiences of family disconnectedness (although this was not formally assessed in this study).

Influence of Developmental Timing of ACEs

The current study found that ACE burden during adolescence predicted worse post-traumatic stress and depressive symptoms, and poorer interoceptive awareness (e.g., self-regulation and body listening), relative to other developmental stages. Young childhood ACEs predicted greater resilience. None of the developmental stages posed significant risk or benefit, above other stages, for generalized anxiety, emotion regulation, alexithymia, post-traumatic growth, self-reported EF, and cognitive-intraindividual variability. Importantly, this does not

imply that trauma at any one developmental stage was not associated with these outcomes, but rather that it did not explain unique variance in the outcomes. These null results must also be considered in the context of a cross-sectional design and relatively small sample size.

The current findings add nuance to the literature on "childhood trauma", demonstrating that adolescence may be a particularly sensitive age range during which ACEs can lead to challenges with adult mental health and aspects of interoceptive awareness. It was originally hypothesized that young childhood trauma would pose particular risk for adult mental health, and this relationship may be true under normal circumstances; during the current pandemic, however, the recency of adolescent experiences for the primarily young to middle-aged adult participants may have been especially harmful. These adults may not have had enough time to process and transform adolescent trauma, and the adolescent experiences may still be contributing to severed family relationships, thus interfering with a sense of family connectedness that has elsewhere been shown to buffer the impact of the pandemic (e.g., Hyun et al., 2021; Vindegaard & Benros, 2020). It is also possible that while the early childhood sensitive period poses significant risk for mental health among children, an additional dose of adverse rather than supportive experiences during the second adolescent sensitive period may be especially determinant of adulthood experiences. For instance, Hawes and colleagues' (2021) found that experiences during infancy explained unique variance in PTSD symptoms among children, while the experiences of these children's mothers and fathers during middle childhood and adolescence, respectively, were uniquely predictive of parental psychological distress.

The risk that adolescent ACEs posed for interoceptive awareness in this study was consistent with the hypothesized association. Neuroimaging evidence suggests that areas associated with executive control (i.e., anterior cingulate cortex, orbito-frontal cortex, and left

pre-frontal cortex) come online with age as children and adolescents engage in interoceptive processing (Klabunde et al., 2019). Interestingly, the two MAIA subscales of Body Listening and Self-Regulation were particularly impacted by adolescent trauma, and both subscales involve obvious executive control, such as using bodily sensations to inform decision-making (e.g., Damasio, 2000), and intentionally returning awareness to one's body in the midst of emotional distress. Overall, the predictive power of adolescent trauma for later-life coping conveys the importance of preventative interventions for at-risk adolescents. Also, mental health services offered during the pandemic should be tailored to adults with prior adolescent adversity. Clearly, adolescent experiences warrant special clinical attention during assessments and interventions, such as while obtaining details of a client's history, and when considering experiences that underlie a client's mental health concerns and emotional and behavioral regulation.

The results revealed a counterintuitive finding that young childhood ACEs predicted greater resilience. Not only was young childhood ACE burden the only significant predictor relative to other developmental stages, but it was also the only positive predictor. This evidence may support theories of stress inoculation (e.g., Katz et al. 2009), in which early life stress bolsters adaptive regulation of arousal later in life. This contrasts with other findings (e.g., Simeon et al., 2007) that childhood trauma is negatively associated with resilience. Parsing childhood trauma into distinct developmental stages in the present study may have revealed a nuance about trauma before age six, which was not yet evident in the literature. Resilience refers to returning to baseline after stress, and persons with traumatic experiences very early in life may have an altered sense of baseline or normal, as adversity within the caregiving relationship would shape their developing brain and neurobiological attachment system. Further, after early childhood, there are additional opportunities for adaptive learning, such as during the second

sensitive period in adolescence (e.g., Gee & Casey, 2015). Given that ACEs increased in frequency with age in this sample, it is unlikely that adversity was confined to younger years; however, it is possible that stress inoculation was supported by benevolent experiences and resources that became increasingly available as children began attending school and widening their social circle outside of the home. Measurement of such "counter-ACEs" (Crandall et al., 2019) was lacking in the current study. Another consideration related to the global context of the study, is that individuals with early-life trauma may have learned from a young age how to cope with struggles such as social isolation, food insecurity, and mental health challenges such as anxiety and depression, which many adults faced for the first time during the COVID-19 pandemic. They may also have an entirely different perspective on pandemic-related challenges, relative to other challenges they have survived. Thus, respondents with early life trauma may have responded to the Brief Resilience Scale with greater self-efficacy for coping with stress, relative to their impression of how others in society are coping. That said, the current results are limited by accuracy of ACE measurement and recall. Young childhood events are often encoded as pre-verbal sensory or implicit memories, which may not have explicit relevance to current functioning (e.g., Perry & Winfrey, 2021). The high percentage of missing or "don't know" responses for young childhood events indicates that dissociation or other coping mechanisms likely also interfered with memory or reporting of sensitive or distressing events.

Limitations and Future Directions

ACE measurement is a notable limitation of this study, which was subject to recall biases and exclusive of benevolent experiences. The Traumatic Antecedents Questionnaire was used to gather participants' reports for an array of ACEs, at distinct developmental stages; ACE burden scores were extrapolated from this information. Unfortunately, there is a dearth of measures

designed to examine the developmental timing of ACEs, rather than looking at ACEs as a global metric across childhood, as Felitti and colleagues' (1998) original ACE measure has done. Hawes and colleagues (2021) have published a promising developmentally-sensitive caregiver report of ACEs in the lives of their children and themselves, titled the Adverse Life Experiences Scale (ALES); this measure relies on caregiver reports and is designed for children up to age 12, or early adolescence. An advantage of the ALES apart from ACE timing, is expansion of ACE types to include minority discrimination, war, and peer victimization. Such experiences are arguably directly relevant to how individuals are coping mentally and emotionally during the COVID-19 pandemic, given pandemic-related experiences of acute racism and discrimination, global conditions akin to wartimes, and reliance on social support from peers.

Complementary to developmentally-sensitive measurement of ACEs, is consideration of the construct validity of psychological and emotional outcomes measures at each developmental period. For instance, the language of the MAIA has been revised for children and adolescents (Jones et al., 2020); it is possible that the adult version of the MAIA does not reflect the abilities gained – or lost – during earlier stages of child development and adversity. The current study results depict how ACEs during young childhood and adolescence have uniquely impacted current levels of functioning on adult-oriented measures.

Longitudinal and prospective study designs would surpass the difficulties inherent in this cross-sectional examination of retrospective ACE recall and current adulthood functioning. Such designs could include developmentally-sensitive measures of adversity across infancy, childhood, adolescence, and adulthood, and capture effect sizes for relevant outcome measures at each stage. Longitudinal studies extending into the post-pandemic phase will be well-positioned to evaluate post-traumatic growth and resilience in terms of bouncing back to a potentially new

baseline curated during the pandemic. Further, additional associations between developmentally-sensitive CCT exposure and psychological or cognitive outcomes may emerge with a larger sample size. Additionally, inclusion of comparison groups (e.g., non-CCT-exposed, other-trauma-exposed, and psychiatric CCT-exposed), could better answer questions such as: "How do CCT exposure and psychiatric status uniquely impact functioning during a global crisis?".

Conclusion

During the COVID-19 pandemic, the current community sample of adults with CCT histories presents with considerable mental health challenges, along with levels of alexithymia and interoceptive awareness comparable to other reports of psychiatric trauma-exposed samples. While the vast literature on ACEs has amalgamated childhood experiences, the current study measured timing of adversity with more precision, revealing that ACEs at certain stages can be uniquely beneficial or harmful for interoceptive awareness, mental health, and resilience. As the global pandemic wears on and mental health moves to the forefront of societal concern, there is a vital need for assessments and interventions that address (1) childhood trauma, and adolescent experiences in particular; and (2) underlying substrates of mental health, such as interoceptive awareness and alexithymia. Future studies are encouraged to continue to illuminate the impact of ACEs on the developing child, adolescent, and adult.

Chapter 3: Trauma-informed mindful embodied (TIME) yoga: A neuropsychologically-informed intervention

Abstract

Yoga is a holistic and mindfulness-based practice, with potential to address neurodevelopmental alterations and self-regulation difficulties in adult survivors of complex childhood trauma (CCT). This study presents a standardized protocol for the newly created TIME yoga program, along with feasibility results of an initial randomized controlled trial. 13 of 26 community-dwelling adults with self-identified CCT exposure were randomly assigned to TIME yoga. With progressive themes of grounding, resourcing, rhythms, and play, TIME yoga was delivered online and asynchronously over four weeks, near the beginning of the COVID-19 pandemic. Each week, participants self-reported program attendance and completion rates, at-home session quality, and adverse effects. At one-month follow-up, eight participants answered an open-ended question about their experiences in TIME yoga. Attrition and non-response rates were minimal. On average, participants completed 77% of the program, with relatively high treatment quality in terms of consistency and environment of at-home yoga practices. No adverse events were reported. Self-reported barriers to adherence, program benefits, and suggested program improvements are discussed, in the context of trauma-related and pandemic-related disruptions. Given the initial indicators of feasibility and safety, intended program developments are presented.

Introduction

Complex childhood trauma (CCT) survivors have endured repeated exposure to adversities within their relationships with caregivers and significant people in their lives. Often referred to as *adverse childhood experiences (ACEs)*, such events are of an interpersonal nature and can include maltreatment and household dysfunction (e.g., neglect, witnessing trauma, exposure to familial substance abuse or psychopathology, separation from caregivers, and physical, sexual, or emotional abuse; Felitti et al., 1998; Karatekin & Hill, 2018). Mental health repercussions of CCT can include anxiety, depression, and substance abuse, all of which may be exacerbated during the coronavirus 2019 (COVID-19) pandemic due to factors such as social isolation, physical inactivity, financial stress, fear, uncertainty, and loss of control (Pfefferbaum & North, 2020). Such mental health problems economically burden Canada, with pre-pandemic estimates of $50 billion spent annually (Centre for Addictions and Mental Health, n.d.; Mental Health Commission of Canada, 2017); numbers are likely to rise with the increasingly documented mental health effects of living through the pandemic (e.g., Vindegaard & Benros, 2020). Even in the absence of readily identifiable mental illnesses, survivors can carry longstanding self-regulation difficulties into their adult lives, due to disruptions in attachment relationships and neurophysiological development (Perry, 2006; Schore, 2014; Teicher & Samson, 2016). Unfortunately, mental health services are not accessible to many Canadians, with cost, stigma, cultural and language barriers, geographical location, staff shortages, and wait times being among the documented barriers (Moroz et al., 2020). There is a vital need to generate cost-efficient and community-based services, particularly in virtual formats that harness the surge in interest and acceptance of technology during the pandemic (Moroz et al., 2020).

Applicability of Existing Trauma Treatments for CCT Survivors

Talk-based exposure and cognitive therapies are considered "gold-standard" for single-incident PTSD (Foa et al., 2009; ISTSS, 2018). However, these have limited applicability to persons with CCT (Corrigan & Hull, 2015; Ford & Courtois, 2020; van der Kolk, 2002). Exposure techniques are less tolerable for individuals with Complex PTSD, and may result in attrition or worsening of symptoms (e.g., Ford & Kidd, 1998; McDonagh-Coyle et al., 2000; Zayfert et al., 2005). Adults with CCT often struggle with accessing internal resources to help them cope with processing trauma, such as being able to refer back to feelings of safety and connection with caregivers (Parnell, 2013). Without these resources, survivors may rely on defensive accommodations (e.g., dissociation), and either avoid therapeutic stimuli or endure re-traumatization by virtue of re-living trauma without being grounded in the present (e.g., Kain & Terrell, 2018b; van der Kolk, 2002). Currently, there are no gold-standard psychotherapies for CCT survivors. The International Society for Traumatic Stress Studies (ISTSS; 2018) has called for development of mindfulness-based interventions as one avenue to address the psychophysiological disruptions in self-regulation which are present for many CCT survivors. Adjunctive mind-body interventions can address the somatic, emotional, behavioural, interpersonal, and spiritual components of distress that are characteristic of CCT survivors with Complex PTSD (Smith & Ford, 2020). "The Expert Consensus Treatment Guidelines for Complex PTSD in Adults" released by the ISTSS in 2012 stated that psychotherapy should be a multi-phase process, beginning with a stabilization phase focused on establishing safety, self-regulation skills, and psychosocial competencies (De Jongh et al., 2016). There is limited evidence that verbally-oriented stabilization methods – which do not directly address physiological dysregulation– are effective in the initial phase (Cloitre et al., 2002; De Jongh et

al., 2016). Yoga, as a mind-body intervention, may be one way to cultivate safety and stabilization for CCT survivors as a "phase 1" form of intervention. Accordingly, this paper has three main aims: (1) to review the existing rationale and evidence for yoga as a healing modality for trauma; (2) to present a standardized protocol for TIME yoga; and (3) to present feasibility results of an initial RCT.

Yoga: A Mind-Body Intervention

Historically speaking, yoga is an ancient Indian healing practice believed to alleviate suffering and unite the individual's consciousness with the universal or divine consciousness (Iyengar, 2002). Mental and physical health are both considered essential in this union. Patanjali refined Ashthanga Yoga, which is an eight-fold path of yoga that incorporates the following practices: *yama* (universal morals), *niyama* (individual discipline), *asana* (posture), *pranayama* (breath control), *pratyahara* (sensory control), *dharana* (concentration), *dhyana* (meditation), and *samadhi* (bliss). These eight limbs have been conceptualized as means of regulating emotions, thoughts, physiology, and behaviours in order to enhance well-being (Cope, 2006).

Over the past few decades, yoga, mindfulness, and other contemplative practices have been incorporated into mainstream Western culture, including healthcare. Mindfulness and yoga practices within healthcare originally appeared in mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982) for chronic pain, and mindfulness was later applied to treating various mental and physical illnesses, as in dialectical behaviour therapy (DBT; Linehan, 1993) for complex trauma symptomology in the context of borderline personality disorder. Yoga is a mindful practice that incorporates intentional and non-judgmental awareness of the unfolding of thoughts, emotions, and physical sensations over time (Russell & Arcuri, 2015). Yoga not only enhances trait mindfulness (e.g., Gard et al., 2012), but also induces physical sensations and encourages an

attentional focus on the body, thus offering practitioners additional tools for embodiment, or the sense that "I am my body" (Gard et al., 2014) – something that may be awry in CCT survivors. In addition to fostering attention to physical sensations rather than thoughts or emotions, yoga does not involve remaining stationary for long time periods, and it targets development of motor skills and patterns; thus, it is ideal for individuals who suffer from especially distressing thoughts and images, compromised attentional abilities, hyperactivity, and changes in motor functioning (Russell & Arcuri, 2015). These are all facets of traumatic stress. Further, while dissociation can be an adverse effect of stationary embodied practices, yoga can actually improve dissociation, as in a study of an intensive 20-week trauma-sensitive yoga program for women with chronic and treatment-resistant PTSD (Price et al., 2017). Evaluating yoga as a standalone therapy for traumatic stress is an emerging area of research, with relatively low-quality evidence due to few RCTs and small samples; yet, it seems that yoga can improve symptoms of PTSD (Cramer, Anheyer et al., 2018) as well as often comorbid conditions such as depression and anxiety (Balasubramaniam et al., 2012; Cramer, Lauche, et al., 2018).

Yoga as a "Bottom-Up Approach" to the Treatment of CCT

Cognitive-behavioural and insight-oriented therapies foster conscious understanding that traumatic events and associated emotional and somatic reactions belong in the past and are no longer adaptive in the present (van der Kolk, 2002). Neuroimaging studies conducted with individuals with single-incident PTSD show that cognitive-behavioural and narrative therapies enhance *top-down* regulation of fear, whereby prefrontal or parietal neural areas down-regulate amygdalar activity (Adenaur et al., 2011; Felmingham et al., 2007). Talk-based approaches can help individuals to "override" but not "abolish" autonomic nervous system responses (van der Kolk, 2002). When survivors relive their trauma, neuroimaging shows right hemispheric limbic

activity, and reduced pre-frontal cortical and left hemispheric activity - particularly in Broca's area, which mediates speech (van der Kolk, 2015). This presents a "tyranny of language", since verbalizing and rationalizing are often inaccessible skills during an acute traumatic stress response, such as flashbacks or re-experiencing (van der Kolk, 2002). *Bottom-up* interventions stimulate peripheral somato-, viscero-, and chemo- sensory receptors known to influence cognitive processes via afferent pathways to the brainstem and cortex (e.g., Taylor et al., 2010). Mind-body interventions, such as mindfulness and yoga, combine top-down and bottom-up strategies. Such approaches can equip survivors with tools to manage emotional and somatic traumatic stress responses, without relying solely on prefrontal neural engagement.

Perry's (2006) neurosequential model of therapeutics provides a neurodevelopmental rationale for bottom-up treatment techniques for CCT. This model essentially replicates the sequence of development– first targeting the functionally lowest neural region that is affected by early life trauma, and progressing to higher regions (Perry & Hambrick, 2008). Thus, the initial focus is on the brainstem and diencephalon, which contain stress-response systems and are sensitive to experiences beginning in-utero and during infancy. According to Perry, "rhythm is regulating", and patterned, repetitive, and rhythmic somatosensory input can reorganize these regions that associate rhythms (e.g., maternal heart rate) with safety (MacKinnon, 2012). This explains why rhythmic yoga movements and breathing can evoke profound feelings of safety.

Further, according to Schore's (2014) right-brain model, yogic movement, breathing, and chanting, would conceivably stimulate right-lateralized emotional processes and non-verbal communication systems (i.e., visual-facial, auditory-prosodic, and tactile-gestural), which are essential to attachment and emotional resilience. From this neurophysiological lens, *attachment* refers to a caregiver's regulation of an infant's bodily and affective states via nonverbal

communications, originating from and received by the caregiver and infant's right brains (i.e., co-regulation). Secure attachment develops when caregivers are attuned and responsive to the child's biological and affective states, providing a predictable balance of soothing and stimulating activity. The caregiver then becomes a secure base for the child to freely alternate between exploring the environment and returning to the caregiver. Secure attachment buffers children from the effects of stressful and even traumatic situations. It promotes central nervous system development, including right frontal-limbic circuitry, which enables the child to cope with future stressors (Schore, 2009). The attachment bond creates in the child an internal working model (Ainsworth, 1985), which forms the basis of views of self, others, and the world, thus setting the stage for emotion regulation and social behaviours in adulthood. When a caregiver does not reliably attune and respond to the infant's needs, attachment trauma is imprinted into right brain cortical-subcortical systems. Right-brain stimulation is considered a key ingredient of psychological intervention, occurring through interactive affect regulation between therapist and client, and serving to re-wire attachment (Schore, 2014). In yoga, this regulation could possibly occur between teacher and practitioner, or even within a practitioner as one regulates one's own affective and bodily states, via sight, sound, touch, and movement.

Healing Mechanisms of Yoga

Several mechanisms of action have been proposed to explain why yoga promotes healing and optimizes health, including: (1) recalibration of homeostatic physiology; (2) increase in practitioners' interoceptive and metacognitive awareness; (3) physical conditioning and lifestyle benefits; (4) training of attention and executive functions; and (5) offering ethical guidelines which encourage a compassionate stance towards self and others. The highly holistic and

integrative approach of yoga is well-suited to the complex and multifaceted nature of complex trauma, and will be explored in more detail below.

Homeostatic Physiology

Yoga's most powerful influence on homeostatic physiology is arguably its impact on the vagus nerve, which is implicated in breathing, meditation, and chanting exercises (e.g., Cramer, 2016). In a bottom-up manner, stimulation of somatic, sensory, and visceral receptors during yoga has been linked with improved functioning in lower-level brain structures, including the vagal complex (Gard et al., 2014). Diaphragmatic breathing has actually been shown to functionally alter baroreceptors and vagal afferents. It has been posited that yoga operates similar to vagus nerve stimulation procedures, which increase parasympathetic and GABA activity, functionally alter the amygdala and hippocampus, and reduce allostatic load associated with overreliance on the sympathetic nervous system (Streeter et al., 2012). Yoga essentially calms the body, through quieting the HPA-axis stress response, reducing cortisol secretion and sympathetic activity, and increasing heart-rate variability (Meyer et al., 2012; Sengupta, 2012; van der Kolk, 2015). Further, yogic practices of breathing and chanting can improve emotional wellness by impacting heart-rate oscillations and consequently blood flow in the brain; for instance, reciting a yoga mantra can slow the breath rate to an individual's resonance frequency, which can lead to high amplitude oscillations in heart rate and simultaneous increases in functional connectivity within limbic regions subserving emotion regulation (Mather & Thayer, 2018).

Interoceptive and Metacognitive Awareness

Yoga increases survivors' awareness of their inner world (Neukirch et al., 2019). Interoceptive awareness refers to a sense of one's physiological condition – including emotional

states – based on conscious perception of physical and autonomic nervous system sensations (Craig, 2002). Relative to matched controls, North American yogis have shown increased gray matter volume in neural regions underlying interoceptive awareness, such as the insula, cingulate cortex, medial prefrontal cortex, and inferior and superior parietal lobule (Villemure et al., 2014). Interoceptive awareness is crucial for managing affective, cognitive, and social processes, and making "intuitive" decisions informed by one's emotional state (Damasio, 2000). However, excessive bodily focus in the context of hypervigilance, rumination, and over-interpretation of sensations, is a sign of somatization, anxiety, and depression (Mehling et al., 2012). In yoga, metacognitive awareness – that is, "stepping back" to non-judgmentally observe one's sensations, thoughts, and emotions – is an essential counterpart to interoceptive awareness (Schmalzl et al., 2015). Metacognitive awareness supports the yogic conceptual teachings of compassion and impermanence, which additionally involve positive reappraisal of somatic experiences, for example as sensations that will pass (Gard et al., 2014). Along with interoceptive changes, yoga practitioners have evidenced increased pain tolerance (Villemure et al., 2014), and yoga has increased college students' self-compassion, non-judgmental self-reflection, and emotion regulation (Sauer-Zavala et al., 2012).

Critically, yogic postures and movements are coordinated by the vestibular system, which relies on proprioceptive input derived from both interoceptive and exteroceptive signals; this multisensory input arrives at the vestibular nuclei of the brainstem and is processed cortically at the parieto-insular vestibular cortex and somatosensory and motor regions, in order to facilitate awareness of one's bodily self in the context of one's environment (Harricharan et al., 2017). PTSD and its dissociative subtype have each been associated with unique disruptions in functional connectivity between vestibular nuclei and cortical regions. The physical sequences of

yoga may be ideally suited to remedy these sensory disruptions and bolster survivors' sense of embodiment and ability to navigate the physical world.

Physical and Lifestyle Factors

Yogic postures and breathing exercises contribute to improvements in physical conditioning, including cardiovascular fitness, muscular strength and endurance, balance and coordination, and flexibility (e.g., McCall, 2013; Telles et al., 2014). Yoga promotes a balanced lifestyle overall, in terms of better sleep quality as well as healthier decision-making and goal-directed behaviour related to physical activity and eating. Lifestyle benefits may be attributed to interrelated factors of physical fitness, cognitive functioning (see below), attention to one's body, and yogic teachings for care of oneself and the environment. Over time, increases in self-efficacy may additionally serve to counter learned helplessness and immobilization responses to trauma, and ultimately further enhance goal-directed efforts (e.g., Gard et al., 2014). Physical fitness and lifestyle improvements are particularly important in the context of CCT, where physical illnesses and risk-taking behaviour are prevalent, presumably in part because individuals are not attending and responding to their body's needs. Yoga reduces occurrences of high-risk behaviours and diseases associated with CCT, including hypertension, smoking, and substance abuse (Bock et al., 2012; Bond et al., 2013; Cramer, 2016; Gard et al., 2014).

Cognitive Functioning

Yoga has a moderate effect on attention, processing speed, executive functioning (EF), and memory (Gothe & McAuley, 2015). EF improvements may be mediated by bottom-up pathways between the brain stem and prefrontal cortex, as per the neurovisceral integration model (Thayer et al., 2009). As well, EF is enhanced by the motor sequencing, planning, learning, and decision-making involved in moving through yoga sequences (Schmalzl et al.,

2015). Top-down processes of intention or goal setting and maintenance in yoga may also improve attention and inhibitory control (Gard et al., 2014).

The continuous and conscious allocation of attention in yoga can be likened to a form of cognitive training for sustained and selective attention. Meditative practices are often conceived as harnessing either focused attention or open monitoring (Lutz et al., 2008). Similar to mindfulness practitioners, it is thought that novice yoga practitioners predominantly engage focused attention on one element of practice at a time (e.g., on breath, body position, eye gaze point, or arising sensations or emotions; Schmazl et al., 2015; Silveira & Smart, 2019). With practice, individuals may progress to open monitoring, or simultaneously observing movement, breath, and sensations. For both attentional methods, the emphasis on continuously returning attention to the present moment would help individuals with CCT to stay grounded in the here-and-now in the face of acute dysregulation due to their symptoms.

Yoga encourages intentional eye gaze towards specific parts of the body or environment (Schmalzl et al., 2015); this may be another form of attention training that reduces trauma-related attentional bias to threatening information. Yoga incorporates both upward and downward eye gazes, which promote allocentric and egocentric referencing; this may help one to watch the environment with less biases based on personal traumatic experiences (e.g., Sdoia et al., 2004; Austin, 2009). Notably, eye movements that scan the environment may be considered "orienting", which from an evolutionary lens helps one to notice signals of threat or opportunity, and has been implicated as a helpful mechanism in trauma treatment (Jeffries & Davis, 2013).

Ethical Guidelines

Yoga is a "wisdom-based" practice that is grounded in an ethical framework (Cope, 2006). The *yamas* and *niyamas* form a moral code of conduct which includes nonviolence,

truthfulness, non-stealing, non-excess, non-possessiveness, purity, contentment, self-discipline, self-study, and surrender (Iyengar, 2002). The nonviolence and contentment principles are thought to relate to self-compassion, which is cultivated through yoga, and mediates enhanced well-being and reduced stress (Gard et al., 2012). Although ethics are not usually explicitly taught in Western classes, they may be communicated indirectly through a teacher's modeling, intention-setting, and style of instructing that is non-judgmental, gentle, and interpersonally aware (Gard et al., 2014). Metacognitive awareness and discernment in yoga are also thought to implicitly affect moral reasoning and decision-making, both of which have shown improvements after MBSR, which incorporates yoga without explicit ethical guidelines (Shapiro et al., 2012).

Trauma-Sensitive Yoga

Many of the aforementioned studies refer to forms of yoga that are taught to a plurality of persons and are not tailored for any one population. In contrast, trauma-sensitive yoga (TSY) emerged in 2002 as a modified and manualized approach to teaching yoga for trauma survivors (Emerson & Hopper, 2011). TSY aims to empower individuals to reclaim their bodies, through first feeling comfortable and in control of the body, then befriending the body by learning and choosing movements that feel good, and eventually using the body as a resource to self-regulate through breathing and soothing movement. The TSY protocol includes 10 weekly one-hour group yoga sessions, and four audio tape-guided home practices (West, 2011). Each session involves 5 minutes of diaphragmatic or focused breath, 5 minutes of guided meditation, and 50 minutes of asana. The classes center on four key themes: (1) *Experiencing the present moment* (i.e., through awareness of breath and physical sensations); (2) *Making choices* (i.e., to modify, forego, or stay in a particular posture); (3) *Taking effective action* (i.e., moving in a way that feels good, comfortable, or relaxing); and (4) *Creating rhythms* (i.e., synchronizing breath with

movement, and moving in synchrony with others). TSY teachers use invitational language to encourage curiosity and ownership in relation to one's body (e.g., "I invite you to", "If it feels good", "To your own degree", "In your own time"). Furthermore, TSY teachers take several precautions not to "trigger" students. These precautions include: focusing only on the present moment, rather than translating themes to life outside of the class; avoiding chanting or using Sanskrit language other than "Namaste", due to potential triggering or exclusion of certain individuals; avoiding touching or physically assisting students for the first several weeks or months of class; encouraging students to choose more comfortable movements when they encounter discomfort; and being extremely selective of or altogether avoiding vulnerable postures focused on the belly, core, hips, and chest.

Pilot studies of TSY versus DBT for PTSD show reductions in intrusive and hyperarousal symptoms (van der Kolk, 2006). TSY is also a promising avenue for CCT survivors. It has been evaluated in comparison to supportive women's health education among women with chronic, comorbid, and treatment-resistant PTSD secondary to child abuse (van der Kolk et al., 2014). Decreases in PTSD diagnosis and severity were observed in TSY participants after 10 weeks, and longer-term decreases in PTSD or depression severity at 1.5-year follow-up were predicted by frequency of continued yoga practice (Rhodes et al., 2016). Overall, the initial evidence suggests that TSY is a feasible adjunct to talk therapy for interpersonal trauma (Nolan, 2016).

Limitations of TSY

While TSY is a promising intervention, there are limitations to this approach, including that it has only been evaluated in an RCT as an adjunctive rather than standalone treatment (Nguyen-Feng et al., 2020). Further, TSY seems to focus on trying not to trigger the traumatic stress response. This is somewhat futile given that teachers cannot curate a trigger-free

environment for every participant, as triggers are often so personal and idiosyncratic. Attempts to avoid all triggers may result in overt or non-verbal cues that convey fear, control, or defensiveness towards participants. Moreover, according to the window of tolerance framework (e.g., Kain & Terrell, 2018b), expanding one's ability to manage difficult physical sensations involves gradually immersing oneself in zones of hyper- and hypo-arousal, and maintaining vagal regulation within these zones; this can ultimately be more empowering for an individual than a focus on simply calming the nervous system, which is likely unrealistic to maintain across all contexts. The opportunity to experience safe and tolerable hyper-arousal is especially relevant for CCT survivors who may be in chronic states of depression, which is mediated by hypo-arousal and dorsal vagal physiology. Additionally, TSY does not explicitly teach individuals about how trauma typically manifests in the body and everyday life; yet psychoeducation is an integral first step to helping individuals to understand and befriend their body (e.g., Cloitre et al., 2011; Porges, 2011). It can also bring some sense to the experience of internal chaos that is often part of the complex trauma experience.

Trauma-Informed Mindful Embodied (TIME) Yoga

TIME yoga is a trauma-informed approach newly developed by the principal investigator (K. Silveira). TIME yoga incorporates tools grounded in yogic philosophy, attachment theory, Levine's (1997) somatic experiencing principles, Porges' (2011) polyvagal theory, generalized unsafety theory of stress (Brosschot et al., 2017), sensory processing (Harricharan et al., 2021), and Siegel's (1999) window of tolerance framework, in order to more fully harness the power of yoga for building self-regulatory capacity. This program was designed to address the prominent self-regulatory challenges faced by CCT survivors. The complete TIME manual is presented in Appendix C for further review, but its main points will be summarized here.

Rooted in both yogic philosophy and a neuropsychological understanding of CCT, TIME yoga harnesses the physical, emotional, relational, and neuropsychological benefits of yoga practice, specifically for CCT survivors. The online intervention format of this yoga program supports the physical health restrictions in place during the COVID-19 pandemic. As a form of telehealth, it may also be feasible during non-pandemic times, for persons who may have limited access to local mental healthcare (Statistics Canada, 2019; Moroz et al., 2020). A systematic review of the feasibility of online hatha yoga for various populations, recorded varying attendance rates, study designs, and online delivery formats across twelve studies (Brosnan et al., 2021). However, no known studies have examined feasibility of online yoga for CCT survivors specifically. Examination of adverse responses to yoga is also missing in the literature (Nguyen-Feng et al., 2020), perhaps due to a popular misconception that all contemplative practice is benign (Van Dam et al., 2018). Considering survivors' risk for self-regulation difficulties, including self-destructive behaviour (Luxenberg et al., 2001), an examination of program completion, adherence, safety, and adverse events is necessary. As such, the current study represents an initial feasibility and acceptability analysis of TIME yoga in a sample of CCT survivors within an RCT framework, recruited during the COVID-19 pandemic.

Methods

Chapter 1 outlines study methods (i.e., participants, measures, and procedures).

Results

Descriptive Statistics

Chapter 2 contains a descriptive summary of baseline subjective and objective measures.

Attendance and Attrition

Of the 13 participants enrolled in yoga, one participant withdrew from the study after completing the first session and missing the three subsequent sessions due to occupationally-related mental illness. Of note, this participant had clinically significant baseline scores on measures of depression and PTSD. Another participant did not complete the second weekly check-in email. These two participants have been factored into attrition and non-response rates, and are not represented in the feasibility data below.

Attendance and completion rates for the remaining 11 participants are summarized in Table 3.01. On average, participants attempted 6.36 yoga sessions (*SD* = 1.86; range = 3 - 8) and completed 5.73 sessions (*SD* = 2.33; range = 1 - 8). Participants completed an average of 95.19% (*SD* = 9.83; range = 66.67 - 100) of the sessions they attempted. Ultimately, they completed an average of 77.16% (*SD* = 25.82; range = 25.00 - 100) of the entire yoga program. 33.33% of participants attempted all eight yoga sessions, and 25.00% of participants completed all sessions.

The primary reason cited by participants for not attempting sessions was schoolwork and stress (accounted for 10 missed attempts across six participants), followed by vacation and travel (five missed attempts across two participants), technical difficulties with accessing the private YouTube videos (three missed attempts between two participants), physical illness (one missed attempt), and procrastination (one missed attempt). Similarly, the most frequent barrier to completing sessions was schoolwork and stress (interfered with completion of four sessions across three participants), followed by tiredness (two incomplete sessions between two participants), attention difficulties (two incomplete sessions for one participant), negative beliefs about yoga performance (two incomplete sessions for one participant), and difficulties with seeing and hearing the yoga videos (one incomplete session).

Table 3.01

Attendance and Completion Rates for the Eight-Session Yoga Program (n = 11)

Feasibility Outcome	*M*	*SD*	Range
Attempted sessions	6.36	1.86	3 - 8
Completed sessions	5.73	2.33	1 - 8
Completed percentage of attempted sessions	95.19	9.83	66.67 - 100
Completed percentage of program	77.16	25.82	25.00 - 100

Treatment Quality

Participants incorporated 78.46% (*SD* = 21.54; range = 50.00 - 100) of the sessions they attempted into a consistent yoga schedule. 36.36% of participants maintained a regular yoga schedule for all attempted sessions. Reasons for deviating from schedule included schoolwork and stress (disrupted 8 sessions across three participants), procrastination (four sessions for one participant), recreational activities (three sessions among two participants), and a family emergency (one session). Three participants opted to catch-up on missed sessions, by completing three or four sessions the following week. All participants were able to practice in a private, quiet, and uninterrupted environment.

Adverse Events

None of the participants reported an increase in thoughts of harm to self or others. As well, no increases in substance abuse, psychosis, dissociation, or traumatic memory re-experiencing were reported to result from their program participation or to present barriers to participation.

Acceptability

Eight participants responded to the one-month follow-up question about their experiences with the yoga program. Their responses are summarized below.

Program Benefits

Feedback about program benefits included: enjoyment of program (*n* = 3), increased motivation and prioritization for self-care activities (*n* = 2), anxiety or stress reduction (*n* = 2), relaxation (*n* = 1), improved coping with the pandemic and school (*n* = 1), positive attitude (*n* = 1), accessibility for beginner yogis (*n* = 1), and psychoeducation and focus on themes (*n* = 1).

Program Adjustment

Participants commented on session length (*n* = 2), indicating that it was difficult to schedule and to maintain focus, and suggesting sessions of varying or shorter lengths; as well as challenges with online delivery and lack of performance feedback (*n* = 1), and inability to maintain stress-reduction benefits after program completion (*n* = 1).

Ongoing Practice

Participants continued to use breathing techniques occasionally or daily, for grounding or for stress and anxiety management (*n* = 3), and noted an increase in physical activity (*n* = 1).

Discussion

This study examined feasibility of an initial RCT of TIME yoga, among a sample of 13 adults with histories of CCT exposure, during the COVID-19 pandemic. Attrition and non-response rates were low - only one participant withdrew from the program, and another participant provided incomplete email responses. The remaining 11 participants tended to complete the sessions they attempted, completing 5-6 sessions on average. Participants completed an average of 77% of the program, and 25% of participants completed the entire program. At one-month follow-up, several participants described various program benefits: anxiety reduction, relaxation, coping with the pandemic and school, positive attitude, self-care, accessibility for beginner yogis, and psychoeducation. Drawbacks to the program included:

session length, lack of in-person performance feedback, and inability to maintain stress-reduction benefits. Three participants continued to practice pranayama in their daily lives after program completion. The feasibility results should be interpreted in the context of the relatively acute pandemic phase in which data collection occurred (i.e., June to December of 2020). In this timeframe, many individuals were adjusting to the far-reaching impacts of the pandemic, including working/schooling from home, increasing reliance on technology, social isolation, fear of infection, etc. It is possible that results may differ in a post-acute or post-pandemic stage. As well, 80% of the current community sample was comprised of undergraduate students, which may impact generalizability of feasibility results to a non-student sample.

Attendance and Engagement

The 77% attendance rate for the current trial exceeds that of a comparable study described in Brosnan and colleagues' (2021) recent review of online yoga trials; specifically, in a study of pre-recorded yoga videos for women with PTSD symptoms after a stillbirth, women in the low-dose group averaged 44 of 60 min of weekly yoga, and those in the moderate-dose group averaged 77 of 150 min (i.e., 51% of the prescribed videos; Huberty et al., 2020). Similar to the current study, Huberty and colleagues reported that barriers to participation included work and school obligations, mood, and timing – the women reported that 150 min of weekly practice was not manageable. The current study additionally examined factors interfering with completing the entire length of sessions; Interestingly, participants noted that common trauma-related and self-regulation difficulties (i.e., fatigue, inattention, negative self-talk) impacted their ability to persevere, though some of these difficulties may also be a by-product of Western culture involving immediate rewards, busy schedules, and fast-paced activity. Given participants' feedback, the TIME yoga series could be enhanced by shortening session lengths, while still

allotting time for psychoeducational and yoga-based components. In fact, Mather and Thayer (2018) suggest that brief 20-minute daily episodes of resonance breathing can promote greater functional connectivity in brain regions subserving emotion regulation, including the medial prefrontal cortex, anterior and posterior cingulate cortex, and insula. Additionally, education can be provided about immediate changes in emotion or mood (e.g., "weather") with shorter yoga practices, versus longer-term neuroplasticity (e.g., "climate") with lengthier sustained practice or consistent measured doses of yoga.

Observations Related to Telehealth Delivery

The current yoga program was well-attended overall, despite evidence of limited uptake of asynchronous virtual mental health resources by individuals struggling with mental illness during the COVID-19 pandemic (Richardson et al., 2020). During the pandemic, the virtual format of the program was preferable, and at times mandated, in order to protect public health and safety. At a time when many individuals are physically confined to their homes, and facing restlessness, boredom, and inactivity in addition to mental health challenges, a yoga and body-based intervention may be more enticing than talk-based virtual services. Additionally, individuals likely perceive the online format as acceptable given the popularity of online yoga programs leading up to and spurred on by the pandemic, such as Alo Moves and Yoga with Adriene (e.g., Brosnan et al., 2021). Indeed, patients report satisfaction with online delivery of mind-body services in particular (Brosnan et al., 2021; Trevino et al., 2021). Telehealth in general is widely accepted by providers and patients alike, and it is associated with high levels of adherence and satisfaction as well as empowerment of patients managing chronic conditions (Kruse et al., 2017). Evidence suggests that telehealth will continue to expand and evolve beyond the COVID-19 pandemic (Gupta et al., 2020).

That said, online asynchronous interventions are associated with benefits as well as drawbacks. Some participants experienced technical difficulties with accessing or following the videos. Further, some participants indicated that barriers to engagement included the lack of instructor feedback about performance as well as self-critical thoughts regarding performance. These participants may have benefited from a synchronous relationship with a yoga instructor. An instructor who is neurobiologically attuned to participants can offer relevant, timely, and personalized feedback about performance, as well as a grounding presence to assist participants with down- or up-regulating arousal and associated thinking tendencies (e.g., Kain & Terrell, 2018b). Still, risk for perfectionistic, self-critical, or even competitive tendencies is present in any format of yoga, and participants presenting with these concerns can be encouraged to develop non-judgmental and compassionate awareness of such thoughts, as part of their trauma-informed yoga practice. While one-on-one therapy is often recommended for severe psychopathology and distress, some CCT survivors may experience an asynchronous relationship as less threatening than a live interaction involving intricate verbal and physical cues; this format may allow them time to build a sense of comfort and safety within their own bodies, before engaging in live talk-based interactions involving feedback from another being.

Asynchronous online delivery of programs is certainly cost-effective for the pandemic-ridden public health system (e.g., Richardson et al., 2020). Continued online delivery would facilitate accessible mental health care for individuals who live remotely or face financial or physical barriers. Asynchronous virtual mental health resources are most frequently utilized by individuals belonging to visible minority groups of South Asian, Middle Eastern, and European origins, perhaps due to anonymity of support (Richardson et al., 2020); thus, asynchronous virtual yoga may help to expand the typical Caucasian ethnic profile of yogis in the West (e.g.,

Brosnan et al., 2021) to include individuals of diverse identities and abilities who may not initially feel comfortable or safe in a yoga studio environment. Indeed, the current sample was 23% non-Caucasian, including participants identifying as Asian, Indigenous, and African Canadian. Still, participants were predominantly young to middle-aged, female-identifying, and working towards an undergraduate degree. There was minimal representation of male and gender queer/non-conforming individuals, as well as students earning lower incomes. Much work is needed to increase diverse representation in yoga studies and studios alike.

Adverse Events

No adverse events were reported in the current trial with respect to thoughts of harm to self or others. Still, distressing changes can be subtle in the context of (a) contemplative practice; (b) learning psychoeducational principles and developing greater understanding of the source of one's distress; and (c) expanding one's psychophysiological window of tolerance. For instance, participants are expected to develop increased awareness of mental, physical, and emotional events; they may experience intense feelings of grief and anger when remembering childhood trauma and learning about its wide-ranging effects; they may develop defense mechanisms such as perfectionism or dissociation, to accommodate uncomfortable levels of physiological arousal (Kain & Terrell, 2018b); and they may choose to make changes in their relationships and lives. Given the important role that trauma-informed yoga teachers play in helping practitioners to navigate distress, recommended teaching credentials and practices are outlined below. Being alert and able to appropriately respond to the nuanced or sometimes subtle effects of yoga participation pertains to the necessary training and qualifications of future TIME yoga teachers, as discussed in the manual found in Appendix C.

Limitations and Future Directions

An inherent limitation of the feasibility data is its self-reported nature. Indeed, one study demonstrated that participants over-reported video completion rates by nearly 27% (Huberty et al., 2019). Self-reports may have been especially biased due to demand characteristics in this initial trial, as the first author (KS) was involved in all aspects of designing and delivering the yoga program and collecting feasibility data. Ideally, future trials would implement blinding procedures to increase reporting accuracy.

Due to constraints of the virtual format, the current TIME yoga series excluded certain elements of yoga that may be particularly powerful for healing from trauma. This includes the element of touch. With consent from the practitioner, skilled yoga instructors can offer physical adjustments to help the practitioner find proper alignment, as well as physical enhancements to encourage the practitioner to deepen the intensity of a posture or to engage or relax specific muscle groups. Practitioners also did not experience the sense of connection that occurs when moving and breathing in synchrony with other yogis. As per the GUTS model, throughout evolution social groups have served as a primary safety signal that inhibits the default stress response (Brosschot et al., 2017). Further, aside from audible breathing practices, the series neglected the element of sound. Vocalizing and listening are essential for the process of social engagement and communication of safety signals (Porges, 2011). With access to proper recording equipment or studios, future series iterations can incorporate chanting (i.e., of the mantra “Om”, which is a universally natural sound vibration; and of opening invocations, which additionally help to set intentions for classes). If chanting is incorporated, the teacher should share English translations and the significance or purpose of each chant.

In this intensive four-week TIME yoga series, there was no assigned homework or booster sessions. As shown by Rhodes and colleagues (2016), and consistent with the broader mindfulness literature, prolonged benefits of yoga for trauma are associated with continued home practice. The TIME series did include psychoeducation which attempted to translate in-class themes to daily life. Further, the series encouraged participants to be their own teachers by improvising movements and moving independently and intuitively with their own breath. Still, there were mixed reviews from participants regarding post-program maintenance of yoga practice and benefits. Future trials can incorporate continued practice, for instance by hosting additional booster sessions, or recommending that participants engage in publicly available community or online classes, or practice re-runs of the series videos once per week.

TIME yoga was delivered as a standalone series, to adults with histories of CCT. Although some program participants did self-report clinically significant symptoms of depression (65%), generalized anxiety (42%), and PTSD (39%), mental health diagnosis and treatment were not required for inclusion. Furthermore, participants were deliberately excluded if they experienced acute trauma and crises, were suffering with a severe mental illness, or were at imminent risk for self-harm. This is in contrast to "trauma-sensitive" yoga, which is delivered in the context of a psychiatric treatment team, to individuals who have been diagnosed with PTSD, and perhaps who present with complex and severe symptomology that has been unresponsive to other treatments (Cook-Cottone et al., 2017). That said, in line with the ISTSS's (2018) research recommendations, future studies may evaluate TIME yoga as one component of a multi-phase treatment process, including evaluating its utility as a stabilizing preface to subsequent trauma processing, in comparison to these treatments alone. Considering the 90% prevalence rate of trauma exposure in the general population (Kilpatrick et al., 2013), TIME yoga may undergo

further evaluation as a “trauma-informed” method of teaching yoga and self-regulation skills to the general public and to individuals with varying forms of trauma exposure other than CCT, provided that individuals are not experiencing the risk factors described above in the exclusion criteria (Cook-Cottone et al., 2017). If participants need additional support, teachers would refer them to local mental health and crisis resources.

Conclusion

This initial RCT demonstrated that TIME yoga is a feasible and safe online intervention for adult survivors of CCT, who are not in severe or acute distress. Readers are referred to Chapter 4 for a report of the effectiveness of the intervention for various trauma-related outcomes, including mental health, cognition, and emotional functioning. TIME yoga may be delivered by trained yoga teachers as-is, to help address rising mental health and self-regulation concerns amidst the COVID-19 pandemic and beyond. In addition, further evaluation is recommended to address the qualitative feedback received from participants. Specifically, trials should include shorter (e.g., 30-minute) video sessions and continued post-intervention practice. Further, variations of in-person or online synchronous teaching can be explored.

Chapter 4: Yoga-related psychological and cognitive enhancements among childhood trauma survivors amidst the COVID-19 crisis

Abstract

Complex childhood trauma (CCT) confers changes in brain function, attachment, and autonomic nervous system regulation, which can manifest in self-regulation difficulties in adulthood. Such difficulties may be exacerbated by the ongoing stress of the COVID-19 pandemic. This study examines the effectiveness of TIME yoga for improving self-regulation among adult survivors, in terms of their psychological and cognitive functioning. In this initial randomized controlled trial, 26 community-dwelling adults with self-identified CCT exposure were assigned to four weeks of online yoga or waitlist. Participants completed a pre- and post- intervention assessment, consisting of objective cognitive tasks and self-report measures of mental health, emotional functioning, cognition, resilience, and post-traumatic growth. Repeated-measures ANCOVAs and post-hoc analyses evaluated intervention effects, revealing decreased depressive symptoms for yoga participants with higher levels of post-traumatic stress symptoms, as well as intervention-related improvements in interoceptive awareness, working memory accuracy, and self-reported executive function (EF). A mediation analysis demonstrated that interoceptive awareness partially mediated improved subjective EF. In terms of clinically significant change, improvements in depression were only evident among yoga participants; yoga and waitlist participants exhibited similar rates of improvement and deterioration in generalized anxiety and post-traumatic stress. Results are discussed in the context of psychophysiological theories of self-regulation and the impact of the pandemic. Further, yoga-related effects (and lack thereof) are compared with the literature on mindfulness-based interventions. Study limitations are acknowledged, and future directions are indicated for evaluating TIME yoga.

Introduction

Of all trauma exposures, events with childhood origins are perhaps the most important public health challenge in the Western world, with pervasive and detrimental effects on mental and physical health later on in adulthood (van der Kolk, 2003). Nearly one third of Canadian adults have endorsed childhood exposure to physical or sexual abuse or intimate partner violence (Afifi et al., 2014) The gravity of childhood neglect and emotional abuse remains understudied (Dubowitz, 2007); however, they respectively accounted for 34% and 9% of substantiated maltreatment investigations in 2008 (Public Health Agency of Canada, 2010).

Childhood adversities within the caregiving system are often interrelated, repetitive, and chronic, such that standalone incidents are rare (Felitti et al., 1998), hence the term complex childhood trauma (CCT) used in this study. CCT confers a strong risk for several of the leading causes of death, including health risk factors and diseases (Felitti et al., 1998). A multitude of comorbid and persistent mental illnesses are also prevalent among survivors, which has prompted the development of the International Classification of Diseases – 11th Revision (ICD-11) category of Complex PTSD, and the description of a symptom constellation termed Disorders of Extreme Stress, Not Otherwise Specified (DESNOS) (Luxenberg et al., 2001). DESNOS entails disturbances in: (1) regulation of affect and impulses; (2) attention or consciousness; (3) self-perception; (4) relationships; (5) somatization; and (6) systems of meaning. A core difficulty with self-regulation is thought to underlie disruptions in these domains. In this study, self-regulation pertains to modulation of one's body and behaviour, occurring via interrelated psychophysiological processes, including emotion regulation, cognitive abilities, and autonomic function. CCT is thought to uniquely impact self-regulation via effects on attachment, the developing brain, and autonomic regulation. For CCT survivors, the

ubiquitous exposure to the coronavirus 2019 (COVID-19) global pandemic may exacerbate emotional vulnerabilities and be especially traumatic for them (Griffin, 2020). CCT may intensify one's physical and mental reactions to the circumstances surrounding the COVID-19 pandemic, considering their resemblance to previous adversities (Pressley & Spinazzola, 2020). Grocery shortages, social distancing, and at-home isolation can prompt memories of food insecurity, neglect, emotional deprivation, and a sense of being trapped. In general, there can be an unsettling feeling of lack of control or choice over one's life – which is a defining feature of any "traumatic" experience.

Complex PTSD symptomology is often less responsive to gold-standard and talk-based trauma therapies for single-incident PTSD, such as exposure-based, cognitive-behavioural, and insight-oriented approaches (Corrigan & Hull, 2015; Ford & Courtois, 2020). The International Society for Traumatic Stress Studies (ISTSS; 2018) has called for investigation of mindfulness-based approaches to address the physiological dysregulation that is prominent among survivors. Mind-body approaches such as yoga, incorporate both top-down and bottom-up regulation of emotional and somatic responses, meaning that they employ neural resources from prefrontal neural areas as well as peripheral somato-, viscero-, and chemo- sensory receptors in the body (e.g., Taylor et al., 2010). Thus, survivors can learn a holistic set of self-regulation strategies.

The current study is an investigation of a newly developed online yoga program for CCT survivors – trauma informed mindful embodied (TIME) yoga. TIME yoga was tailored for CCT survivors, based on a neuropsychological understanding of how CCT impacts self-regulation, as well as holistic knowledge of how yoga improves well-being. The program includes psychoeducation, meditation, breathing techniques, and yoga postures. Interested readers are referred to Chapter 3 for program details and feasibility outcomes based on a preliminary clinical

trial. Below is a brief summary of the literature on self-regulatory changes among CCT survivors, in the context of how outcome measures were selected to assess effects of TIME yoga on substrates of mental health in the current study.

Rationale for Yoga for CCT Survivors in the Era of COVID-19

Yoga as a Form of "Mindful Self-Regulation" Training

Yoga is an ancient Indian practice that enhances mental, physical, and relational wellness. It is a form of mindful movement, in which one intentionally maintains non-judgmental awareness of thoughts, emotions, and physical sensations (Russell & Arcuri, 2015). It is an especially accessible mindfulness-based practice, that enhances trait mindfulness and also induces physical sensations to help one maintain attention on the body (Gard et al., 2012; Gard et al., 2014). Since it does not require long periods of stillness, it is ideal for CCT survivors who suffer from intense distress, reduced attentional abilities, or hyperactivity (Russell & Arcuri, 2015), or who may be prone to dissociation (Price et al., 2017), which could be more easily triggered when sitting motionless for long periods of time. Mindfulness-based practices can help to alleviate complex PTSD symptomology via enhancing attention, improving interoceptive awareness and physiological regulation, and encouraging acceptance (Williston et al., 2020). Yogic movement sequences additionally increase self-regulation in terms of efforts to monitor behaviour, exert willpower, manage impulses, and maintain moment-to-moment motivation to pursue goals (Gard et al., 2014). Self-regulation as a mechanism of action is pertinent to CCT survivors, as this seems to be a core difficulty in this population.

Cognitive Training. As per the cascade model, early-life trauma modifies the sensitivity of the stress-response system, and the consequent increase in stress hormones attenuates neural development (Teicher et al., 2002). Among children and adults with CCT exposure, volume and

connectivity deficits have been consistently evidenced on imaging in the dorsolateral and ventromedial PFCs, and are also apparent in the hippocampus, amygdala, and corpus callosum (Hart & Rubia, 2012). On functional imaging there is altered activity in these regions during tasks involving inhibition, working memory, and emotion processing. The extant literature suggests that CCT leads to cognitive difficulties, particularly in the areas of EF and attention (Bremner et al., 2004; Lu et al., 2017; Masson et al., 2016; Wilson et al., 2011). Neglect is a vastly understudied realm of CCT. Neglected children are thought to experience under-activation in important brain regions (e.g., orbito-frontal gyrus, infralimbic PFC, amygdala, hippocampus, lateral temporal cortex, and brainstem; Chugani et al., 2001), due to lack of stimulation during critical or sensitive time periods (Teicher & Samson, 2016). Adulthood attention-deficit and hyperactivity symptoms are associated with childhood emotional abuse and neglect (Semiz et al., 2017; Tatar & Cansiz, 2019). Mechanisms by which neglect may disrupt attention and EF include dissociation (Semiz et al., 2017), processing speed and white-matter deficits (Tatar & Cansiz, 2019), delayed language acquisition, and relatedly, lack of parental perspective-taking and verbal scaffolding, which typically is internalized by the child as private speech that is a precursor to meta-cognitive awareness (Bernier et al., 2010; Petersen et al., 2015; Vygotsky, 1962).

The neurobiological evidence described above should be considered in light of within-group and within-person variability. Neural alterations depend on factors such as timing and duration of trauma exposure, genetic vulnerability, and gender (Lupien et al., 2009; Teicher & Samson, 2016). Further, there may be moment-to-moment cognitive variability. Attentional variability is indicative of executive dysfunction in various psychopathologies (e.g., Epstein et al., 2011; Kaiser et al., 2008) and is thought to explain diverging processes of avoidance and

hypervigilance in PTSD (Iacoviello et al., 2014). The main finding of Silveira and colleagues' (2020) review was that trauma survivors may appear "normal" on standardized neuropsychological tests scored according to clinical norms. The review suggests that cognitive dysfunction in daily life is likely state-dependent and associated with difficulties managing psychophysiological arousal. Thus, in the current study, cognitive intra-individual variability (IIV) is examined as a potentially sensitive marker of trauma and intervention response. Further, IIV is selected because of its utility as a potentially sensitive measure of self-regulatory changes with contemplative practice, as reflected by medium to large effect sizes in Smart and colleagues' (2021) review of mindfulness as a form of neuropsychological rehabilitation.

Autonomic Nervous System (ANS) Training. In polyvagal theory, Porges (2011) describes how neural circuits detect environmental cues of safety and danger via a primarily unconscious process termed neuroception. Neuroception is informed by both interoception (i.e., noticing one's physiological processes such as heart rate, digestion, and sensations), and exteroception (i.e., perception of surroundings via sight, hearing, taste, smell, touch, balance, proprioception, temperature, vibration, and pain; Kain & Terrell, 2018a). The ability to use cues to distinguish safety from danger, is a first and crucial step of ANS regulation, however, these processes are often awry in trauma survivors. Often survivors do not notice their internal physiological processes (van der Kolk, 2015). In cases of alexithymia, they may have additional difficulty labeling or describing their internal emotional experience.

When threat is perceived, three hierarchical systems support ANS regulation (Porges, 2011): (1) the social engagement system is mediated by the myelinated ventral vagus, and supports symbiotic social interactions via a "face-heart connection" – in addition to calming heart and respiratory rates, it enhances regulation of facial muscles, resulting in greater prosody,

listening ability, and emotional expressivity; (2) the sympathetic-adrenal system is associated with mobilization and fight-or-flight responses including increased heart and respiration rates; and (3) the unmyelinated dorsal vagal system, which is responsible for immobilization, energy conservation, and passive responses such as feigning death and losing consciousness. CCT is often associated with the immobilization response, a sense of learned helplessness, and an external locus of control, after repeated instances of being unable to defend oneself or assert one's needs in the caregiving relationship (Kain & Terrell, 2018a; van der Kolk, 2015). Siegel (1999) coined the term window of tolerance to describe an optimal arousal zone mediated by ventral vagal control (Kain & Terrell, 2018b), which involves being grounded in the here-and-now, feeling safe and connected with others, and being curious and playful. Beyond this window are zones of sympathetically-mediated hyper-arousal and dorsal vagally-mediated hypo-arousal which are experienced as unsafe. In trauma survivors, the window of tolerance is said to be smaller, such that there are fewer situations in which ventral vagal control is predominant (Kain & Terrell, 2018b). A core objective of the TIME yoga intervention is to provide education on, and facilitate expansion of, the window of tolerance. The current study measures effects of yoga within the first stage of ANS regulation (i.e., perception of bodily cues) as well as the ability to express and communicate one's emotions, which are integral aspects of social engagement.

The polyvagal theory is described and referenced here because it has been clinically implicated in many mind-body therapies, and it has a certain utility and allure for describing processes of social engagement, sensing safety, and behavioural arousal states. However, the theoretical and neurobiological principles of polyvagal theory have been seriously questioned in the literature, and it is important to recognize structures beyond the vagus nerve that play a role in regulating behavioural arousal states. In the window of tolerance, for instance, it is plausible

that the spectrum of PFC connectivity with limbic structures contributes to mediating states of hyper-arousal, optimal arousal, and hypo-arousal. This would replicate a Yerkes-Dodson type curve of arousal, and would align with observations of fluctuating frontal-limbic connectivity in PTSD and its dissociative subtype (e.g., Lanius et al., 2010). Polyvagal theory has been criticized for many reasons, including that it misrepresents the process of phylogenesis and the role of the nucleus ambiguus and the nucleus dorsalis nervi vagi in coordinating muscles essential for facial expressions, speech, and middle ear functioning (Liem & Neuhuber, 2021). In fact, the surrounding reticular formation houses many anatomical and functional networks implicated in premotor function as well as cardiovascular and respiratory regulation.

The periaqueductal gray (PAG) is particularly implicated in perpetuating survivors' "survival mode" through the coordination of fight, flight, and immobilization behaviours and arousal states. In response to visceral and sensory input, an innate alarm system is activated by the PAG in tandem with subcortical limbic structures as well as the superior colliculus (Lanius et al., 2017), which is involved in the orienting response that is implicated in PTSD and potentially remedied through regulation of eye gaze and attention in yoga. Harricharan and colleagues (2020) discuss a pattern of interrupted communication of sensory information from brainstem to cortex, supported by several neuroimaging studies which have associated PTSD with increased activation of the PAG, coupled with decreased PFC activity and aberrant connectivity with cortical areas implicated in emotional reactivity. The insula plays a critical and bi-directional role in this neural pathway (Harricharan et al., 2020); it receives exteroceptive and interoceptive sensory input from the brainstem and thalamus, and it is also featured in the viscerosensory system of the cortex which includes the anterior cingulate cortex and ventromedial PFC and helps to inhibit hyperreactivity to sensory information via top-down projections to the brainstem.

Yoga postures produce a host of exteroceptive and interoceptive sensory information, including proprioceptive input processed through the vestibular nuclei in the brain stem. Moreover, the TIME yoga program offers survivors the opportunity to experience these sensations while noticing safety in one's present environment and in one's body. This may be a key bottom-up pathway by which yoga can repair sensory communication between the brainstem, insula, and cortex. Ultimately, this can enable a greater sense of embodiment and efficacy in navigating the physical world, by enabling the multi-sensory integration that occurs in frontal-parietal areas (e.g., Harricharan et al., 2020). Further, this can enhance processes of emotion regulation and EF mediated by the limbic system and PFC.

Brosschot and colleagues' (2017) generalized unsafety theory of stress (GUTS) is based on evidence that sympathetic arousal and perception of threat is actually the "default response" in organisms. This diverges from the polyvagal theory which implies that the perception of threat in one's environment can initiate a non-default fight, flight, or immobilization response. The default state of stress arousal becomes inhibited by the PFC when safety is perceived. Importantly, chronic early life stress, our modern context of COVID-19, and the social isolation that the pandemic perpetuates are factors that would perpetuate the default stress response and underlying sense of uncertainty and unsafety among survivors. Thus, the interpretation of safety cues within one's environment and oneself – which are incorporated in the first two TIME yoga themes of grounding and resourcing - are integral first steps to inhibiting stress arousal and promoting resilience.

Summary and Hypotheses

Understanding how yoga can improve CCT survivors' self-regulation is an emerging area of inquiry. Promising reductions in PTSD symptomology have been observed in a pilot study of

adjunctive trauma-sensitive yoga for women with chronic, treatment-resistant, and co-morbid PTSD stemming from child abuse (van der Kolk et al., 2014). To the authors' knowledge, yoga has not yet been evaluated for addressing aspects of CCT beyond PTSD (i.e., other mental health difficulties, emotional functioning, resilience and post-traumatic growth, and cognition). As well, it is a novel endeavour to assess an online yoga modality during a global health pandemic.

This initial randomized controlled trial (RCT) of TIME yoga explored its effects on survivors' psychological and cognitive functioning during the COVID-19 pandemic. It was hypothesized that, relative to those on the waitlist, yoga participants would exhibit significant improvements in mental health (i.e., depression, generalized anxiety, and PTSD symptoms), emotional functioning (i.e., interoceptive awareness, emotional suppression, and alexithymia), resilience, post-traumatic growth, subjective EF, IIV on objective EF tasks, and working memory accuracy.

Methods

See Chapter 1 for information about this study's participants, measures, procedures, and data analytic strategy. Statistical analyses specific to the current study are described below.

Participant Attrition and Exclusion

Three yoga participants and one waitlist participant did not complete post-intervention testing, including one yoga participant who withdrew during the intervention phase. These participants are not represented in the analyses, as their post-intervention data was unavailable. Other participants were included in analyses regardless of quality or quantity of yoga dose, provided that post-intervention data was available.

Analyses of Variance

Two-way repeated measures mixed ANCOVAs (2 Time) x (2 Intervention) were conducted to evaluate intervention effects on specified outcomes. Age was a covariate in all analyses. Other relevant covariates (e.g., alexithymia scores) are specified below for each analysis. As this exploratory study included several outcomes of interest, where possible, total rather than subscale scores were selected for self-report outcomes, in order to minimize the number of comparisons. In the absence of total scores, specific subscales were prioritized for this study (e.g., emotional suppression rather than cognitive reappraisal was chosen on the ERQ, due to its direct relevance to yogic strategies). Key assumptions were met for all ANCOVAs, including normality, homogeneity of variance, homogeneity of regression slopes, and linearity.

Independent t-tests were conducted to detect baseline differences between yoga and waitlist groups on: self-report measures, ACE burden at each developmental stage, and objective cognitive task performance (i.e., ISD, RT, and accuracy). Data for participants who did not complete post-intervention testing were excluded; the purpose of examining baseline differences in this instance was to detect variables that must be considered in the moderation or interpretation of Time*Intervention interaction results, which are only available for participants who completed post-intervention testing. Of all comparisons, there was a significant difference in PCL-5 scores (t (20) = -2.98, p = .007); the waitlist group scored significantly higher (M = 30.50; SD = 10.14) than the yoga group (M = 17.90; SD = 9.54) on this measure. Since PTSD symptoms differed between groups despite randomization, baseline PCL-5 scores were incorporated as a factor in all analyses (i.e., except for the analyses in which PCL-5 score was itself the repeated-measures outcome), in order to model any impact of PTSD symptoms on the two-way interaction of interest (i.e., intervention*time). In cases where the three-way interaction

(i.e., intervention*time*PCL-5) was not significant, this term was removed from the model, to allow for interpretation of the two-way interaction, which was of primary interest in all models.

The Benjamini-Hochberg (1995) procedure was used to control the false discovery rate (FDR) across all ANCOVAs (see Appendix B for summary table). An FDR of .15 was selected *a priori* for this study, in order to balance risks of type I and II errors within a small-sample exploratory study (e.g., McDonald, 2014). For post-hoc analyses of significant interactions, the decision was made not to correct for the family-wise error rate in multiple comparisons; this exploratory and small-sample research was conducted during the COVID-19 pandemic, and it is important to identify all comparisons driving any intervention*time interactions. For instance, a decrease in mental health symptoms for the yoga group may be accompanied by an increase in symptoms for the waitlist group due to pandemic-related factors, and these simultaneous changes might contribute to an intervention*time interaction for the mental health outcome.

Results

Descriptive Statistics

See Chapter 2 for a summary of baseline scores on subjective and objective measures.

Self-Care Between Yoga and Waitlist Groups

Two Mann-Whitney U Tests were conducted to compare yoga and waitlist participants' self-care strategies for coping during the pandemic. Frequency of pre-intervention strategies did not significantly differ between yoga (mean rank = 12.30) and waitlist (mean rank = 10.83) participants, $U = 68.00$, $p = .628$. Similarly, at post-intervention assessment, there was no significant difference in frequencies of new strategies that yoga (mean rank = 10.88) and waitlist (mean rank = 12.25) participants had implemented during the intervention, $U = 67.50$, $p = .628$.

Two-Way Repeated Measures Mixed ANCOVAs

Table 4.01 summarizes descriptive statistics and significant interactions for all analyzed outcomes. ANCOVA outcomes are further detailed in the sections that follow.

Table 4.01

Summary of Pre- to Post- Intervention Descriptive Statistics and Significant Results

Outcome	Pre- to Post- Yoga *M* (*SD*)	Pre- to Post- Waitlist *M* (*SD*)	Interaction
Mental Health			
PCL-5	17.90 (9.54) to 17.30 (13.06)	30.50 (10.14) to 28.92 (11.45)	
PHQ-9	8.55 (5.05) to 7.20 (5.96)	12.00 (5.58) to 12.50 (5.66)	Time*Intervention*PCL-5
GAD-7	7.20 (4.10) to 7.70 (6.36)	10.42 (5.11) to 9.75 (5.28)	
Emotional Functioning			
TAS-20 Total	48.90 (6.90) to 47.60 (10.48)	53.50 (13.83) to 50.42 (10.48)	
ERQ Suppression	3.90 (1.52) to 3.27 (1.52)	3.33 (1.38) to 3.19 (1.08)	
MAIA			
Trusting	3.07 (1.29) to 3.70 (0.67)	3.06 (1.16) to 2.64 (0.77)	Time*Intervention
Self-Regulation	2.78 (0.98) to 3.38 (0.43)	2.77 (1.30) to 2.29 (1.08)	Time*Intervention
Attention Regulation	2.64 (1.02) to 3.09 (0.63)	2.79 (1.11) to 2.16 (0.91)	Time*Intervention
Body Listening	1.93 (1.14) to 2.87 (0.76)	2.11 (1.74) to 1.92 (1.13)	Time*Intervention
Not Distracting	2.45 (0.96) to 2.65 (1.06)	2.21 (1.29) to 1.71 (0.89)	Time*Intervention
Noticing	3.18 (0.91) to 3.60 (0.46)	3.25 (1.16) to 3.17 (1.23)	
Emotional Awareness	3.08 (1.07) to 3.58 (0.52)	3.27 (1.47) to 3.23 (0.95)	
Resilience and Growth			
BRS	3.38 (0.58) to 3.28 (0.40)	3.06 (0.95) to 3.26 (0.84)	
PTGI Total	29.20 (18.86) to 51.50 (30.39)	40.08 (27.13) to 45.37 (21.07)	
Subjective Cognition			
ACS	51.20 (9.39) to 50.90 (9.34)	48.67 (12.00) to 49.33 (8.66)	
EFI Total	104.60 (8.15) to 104.60 (7.78)	102.08 (13.53) to 100.25 (14.03)	Time*Intervention
Objective Cognition			

ISD Incongruent Flanker	9.06 (2.84) to 9.49 (2.28)	9.75 (3.25) to 9.83 (3.67)	
ISD N-Back	8.07 (2.92) to 9.90 (4.54)	7.65 (2.98) to 8.83 (3.85)	
ISD Go/No-Go	8.39 (2.43) to 9.39 (3.71)	9.97 (5.93) to 8.87 (5.29)	
MCC N-Back	0.77 (0.11) to 0.86 (0.05)	0.82 (0.07) to 0.80 (0.10)	Time*Intervention

Note: n = 12 and n = 10 for yoga and waitlist groups, respectively. For objective cognition measures, n = 9 and n = 8.

Intervention Effects on Mental Health

Three two-way mixed ANCOVAs (2 Time) x (2 Intervention) were used to evaluate changes in symptoms of PTSD, depression, and generalized anxiety.

PTSD. Table 4.02 shows the non-significant two-way interaction for PCL-5 scores.

Table 4.02

Intervention Effects on PCL-5 Scores: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	2.29	.04	.853	.00
Time * Age	1	6.88	.11	.748	.01
Time * Intervention	1	1.75	.03	.871	.00
Error (Time)	19	64.94			
Tests of Between-Subjects Effects					
Intercept	1	1574.44	8.15	.010	.30
Age	1	16.18	.08	.775	.00
Intervention	1	1544.59	8.00	.011	.30
Error	19	193.16			

Depression. The time*intervention*PCL-5 interaction was significant: $\eta p^2 = .19$, (F (1, 17) = 4.06, p = .060), as shown in Table 4.03.

Table 4.03

Intervention Effects on PHQ-9 Total Scores: ANCOVA Results

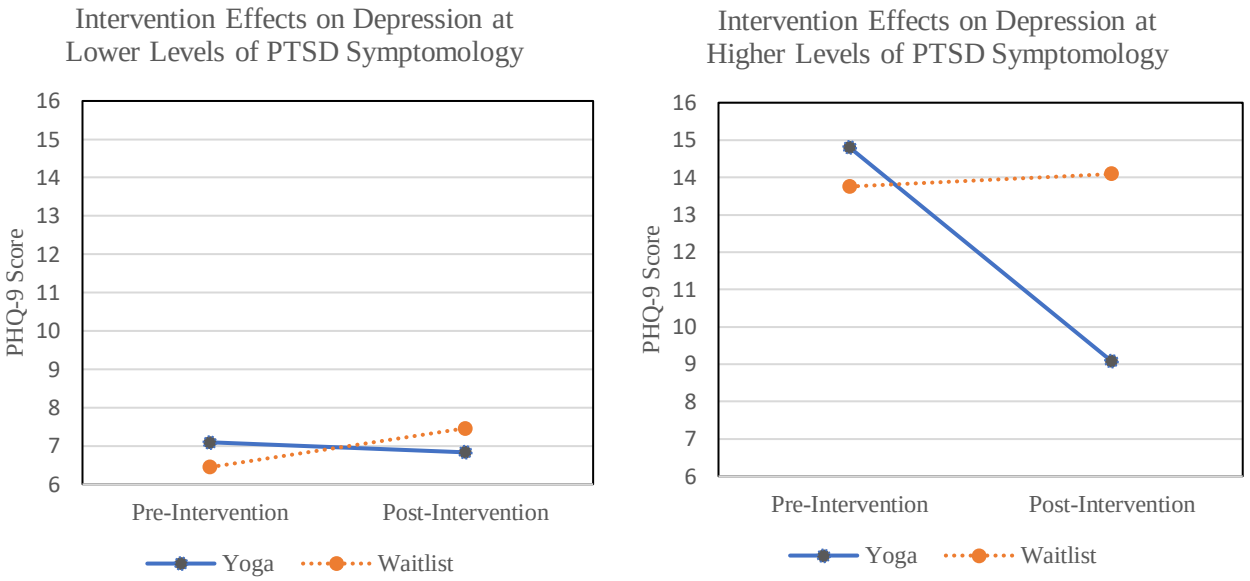
	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	9.72	1.97	.179	.10
Time * Age	1	1.69	0.34	.566	.02
Time * PCL-5	1	27.67	5.61	.030	.25
Time * Intervention	1	4.69	0.95	.343	.05

Time*Intervention*PCL-5	1	20.05	4.06	.060	.19
Error (Time)	17	4.93			
Tests of Between-Subject Effects					
Intercept	1	130.11	4.12	.058	.20
Age	1	125.60	3.98	.062	.19
PCL-5	1	299.19	9.48	.007	.36
Intervention	1	91.51	2.90	.107	.15
Intervention*PCL-5	1	112.63	3.57	.076	.17
Error	18	42.57			

In order to decompose trends in the three-way interaction, the continuous PCL-5 variable was first transformed into a dichotomous variable with levels of higher and lower scores relative to the grand mean. Then, the repeated-measures ANCOVA was conducted with this dichotomous PCL-5 variable, including pairwise comparisons for changes over time within the yoga and waitlist groups, for each level of PCL-5 scores. The three-way interaction with the categorical PCL-5 variable was not significant (F (1, 17) = 1.78, p = .199). Mean comparisons demonstrated a significant decrease in PHQ-9 scores for yoga participants with higher PCL-5 scores, p = .031. There were no significant changes in PHQ scores for yoga participants with lower PCL-5 scores, nor were there significant changes in waitlist participants' PHQ scores at either higher or lower PCL-5 score levels. This time*intervention*PCL-5 interaction is depicted in Figure 4.1.

Figure 4.01

Pre- to Post- Intervention Effects on Depression at Lower and Higher Levels of PTSD Symptomology



Note. Covariates are evaluated at the following values: Age = 25.27.

Generalized anxiety. Table 4.04 illustrates non-significant interactions for GAD-7 scores.

Table 4.04

Intervention Effects on GAD-7 Total Scores: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	3.27	0.29	.598	.60
Time * Age	1	10.61	0.93	.347	.05
Time * PCL-5	1	2.35	0.21	.655	.01
Time * Intervention	1	1.11	0.10	.759	.01
Error (Time)	18	11.36			
Tests of Between-Subject Effects					
Intercept	1	119.96	2.82	.111	.14
Age	1	20.62	0.48	.495	.03
PCL-5	1	114.23	2.68	.119	.13
Intervention	1	2.89	0.07	.797	.00
Error	18	42.57			

Intervention Effects on Emotional Functioning

Two-way mixed ANCOVAs were conducted to assess effects of the intervention on alexithymia, interoceptive awareness, and emotion regulation. Baseline alexithymia scores were a covariate when analyzing effects on interoceptive awareness.

Alexithymia. There were no significant interactions for TAS-20 scores (see Table 4.05).

Table 4.05

Intervention Effects on TAS-20 Total Scores: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	7.02	0.15	.702	.01
Time * Age	1	85.85	1.84	.191	.09
Time * PCL-5	1	119.91	2.58	.126	.13
Time * Intervention	1	7.79	0.17	.687	.01
Error (Time)	18	56.57			
Tests of Between-Subject Effects					
Intercept	1	3699.19	20.75	<.001	.55
Age	1	494.96	2.78	.113	.13
PCL-5	1	0.82	0.01	.947	.00
Intervention	1	74.25	0.42	.527	.02
Error	18	178.31			

Emotion Regulation. No interactions were found for ERQ Suppression (see Table 4.06).

Table 4.06

Intervention Effects on Suppression on the ERQ: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	0.12	0.16	.691	.01
Time * Age	1	0.06	0.08	.787	.00
Time * PCL-5	1	1.89	2.59	.125	.13
Time * Intervention	1	1.97	2.69	.118	.13
Error (Time)	18	0.73			
Tests of Between-Subject Effects					
Intercept	1	1.54	0.66	.428	.04
Age	1	10.17	4.35	.052	.19
PCL-5	1	6.07	2.60	.125	.13
Intervention	1	6.60	2.82	.110	.14

Error	18	2.34

Interoceptive Awareness. Results from the ANCOVAs for the seven MAIA subscales are presented in order of largest to smallest effect size (see Tables 4.07 through 4.13). For Trusting, the time*intervention interaction was significant (F (1, 17) =20.52, p = <.001), with an ηp^2 of .55. Pairwise comparisons demonstrated that yoga participants experienced a significant increase in Trusting over time, p = .001, while waitlist participants experienced a significant decrease, p = .007. For Self-Regulation scores, the time*intervention interaction was significant (F (1, 17) =14.95, p = .001), with an ηp^2 = .47. Pairwise comparisons for Self-Regulation showed that yoga participants' scores significantly increased over time, p = .006, whereas waitlist participants' scores significantly decreased, p = .012. The time*intervention interaction was significant for Attention Regulation (F (1, 17) =11.89, p = .003), with an ηp^2 of .41. Pairwise comparisons revealed a significant decrease in Attention Regulation scores for waitlist participants, p = .005, and a significant increase for yoga participants, p = .045. In terms of Body Listening, there was a significant interaction between time and intervention (F (1, 17) =11.60, p = .003), with an ηp^2 = .41; according to pairwise comparisons, the yoga group's scores significantly increased, p = .002, while the waitlist group's scores did not significantly change. For Not-Distracting, the interaction between time and intervention was significant: ηp^2 = .20, (F (1, 17) = 4.18, p = .057). Pairwise comparisons showed that Not-Distracting scores significantly decreased for waitlist participants, p = .054, and did not significantly change for yoga participants. No significant interactions were found for Noticing or Emotional Awareness.

Table 4.07

Intervention Effects on Trusting on the MAIA: ANCOVA Results

	df	*MS*	*F*	*p*	ηp^2
Tests of Within-Subject Effects					
Time	1	1.01	4.30	.054	.20
Time * Age	1	1.12	4.76	.044	.22

Time * PCL-5	1	1.13	4.79	.043	.22
Time * TAS-20	1	2.09	8.88	.008	.34
Time * Intervention	1	4.82	20.52	<.001*	.55
Error (Time)	17	.24			
Tests of Between-Subject Effects					
Intercept	1	45.85	53.33	<.001	.76
Age	1	.96	1.12	.306	.06
PCL-5	1	.71	.83	.376	.05
TAS-20	1	15.72	18.29	.001	.52
Intervention	1	.13	.15	.700	.01
Error	17	.86			

Table 4.08

Intervention Effects on Self-Regulation on the MAIA: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	.34	1.34	.263	.07
Time * Age	1	.72	2.85	.110	.14
Time * PCL-5	1	.44	1.73	.206	.09
Time * TAS-20	1	.96	3.79	.068	.18
Time * Intervention	1	3.79	14.95	.001*	.47
Error (Time)	17	.25			
Tests of Between-Subjects Effects					
Intercept	1	44.60	55.14	<.001	.76
Age	1	1.51	1.86	.190	.10
PCL-5	1	1.55	1.91	.184	.10
TAS-20	1	18.01	22.26	<.001	.57
Intervention	1	.02	.02	.885	.00
Error	17	.81			

Table 4.09

Intervention Effects on Attention Regulation on the MAIA: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	.31	1.32	.267	.07
Time * Age	1	.15	.62	.440	.04
Time * PCL-5	1	.03	.14	.716	.01
Time * TAS-20	1	.59	2.50	.132	.13
Time * Intervention	1	2.80	11.89	.003*	.41
Error (Time)	17	.24			
Tests of Between-Subjects Effects					
Intercept	1	28.96	24.09	<.001	.59
Age	1	.88	.73	.404	.04
PCL-5	1	.42	.35	.565	.02
TAS-20	1	9.13	7.60	.013	.31
Intervention	1	.07	.05	.819	.00
Error	17	1.20			

Table 4.10

Intervention Effects on Body Listening on the MAIA: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	1.50	3.43	.081	.17
Time * Age	1	.41	.95	.345	.05
Time * PCL-5	1	.67	1.53	.232	.08
Time * TAS-20	1	2.92	6.67	.019	.28
Time * Intervention	1	5.08	11.60	.003*	.41
Error (Time)	17	.44			
Tests of Between-Subjects Effects					
Intercept	1	30.05	15.34	.001	.47
Age	1	1.92	.99	.337	.05
PCL-5	1	.08	.03	.857	.00
TAS-20	1	18.39	9.38	.007	.36
Intervention	1	.07	.04	.854	.00
Error	17	1.96			

Table 4.11

Intervention Effects on Not Distracting on the MAIA: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	1.33	2.55	.129	.13
Time * Age	1	.82	1.57	.227	.08
Time * PCL-5	1	.49	.93	.348	.05
Time * TAS-20	1	.05	.10	.760	.01
Time * Intervention	1	2.18	4.18	.057	.20
Error (Time)	17	.52			
Tests of Between-Subjects Effects					
Intercept	1	5.14	2.76	.115	.14
Age	1	.99	.53	.476	.03
PCL-5	1	2.02	1.08	.312	.06
TAS-20	1	.13	.07	.799	.00
Intervention	1	5.70	3.06	.098	.15
Error	17	1.86			

Table 4.12

Intervention Effects on Noticing on the MAIA: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	.02	.04	.839	.00
Time * Age	1	.22	.43	.521	.03
Time * PCL-5	1	.00	.00	.979	.00
Time * TAS-20	1	.17	.32	.578	.02
Time * Intervention	1	.46	.89	.359	.05

Error (Time)	17	.52			
Tests of Between-Subjects Effects					
Intercept	1	32.28	22.68	<.001	.57
Age	1	.68	.48	.498	.03
PCL-5	1	.06	.04	.846	.00
TAS-20	1	7.07	4.97	.040	.23
Intervention	1	.00	.00	.968	.00
Error	17	1.42			

Table 4.13

Intervention Effects on Emotional Awareness on the MAIA: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	.05	.08	.777	.01
Time * Age	1	.72	1.11	.308	.06
Time * PCL-5	1	.32	.49	.491	.03
Time * TAS-20	1	.04	.06	.812	.00
Time * Intervention	1	1.01	1.55	.231	.08
Error (Time)	17	.65			
Tests of Between-Subjects Effects					
Intercept	1	40.28	30.43	<.001	.64
Age	1	.76	.58	.458	.03
PCL-5	1	2.65	2.00	.175	.11
TAS-20	1	7.51	5.67	.029	.25
Intervention	1	1.24	.94	.347	.05
Error	17	1.32			

Intervention Effects on Resilience and Post-Traumatic Growth

Two-way mixed ANCOVAs were conducted to assess intervention effects on resilience and post-traumatic growth. As in Tables 4.14 and 4.15, there were no significant interactions.

Table 4.14

Intervention Effects on BRS Scores: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	0.14	0.50	.488	0.03
Time * Age	1	0.49	1.75	.202	0.09
Time * PCL-5	1	0.16	0.57	.460	0.03
Time * Intervention	1	0.07	0.25	.623	0.01
Error (Time)	18	0.28			
Tests of Between-Subjects Effects					
Intercept	1	34.32	40.06	<.001	0.69
Age	1	1.12	1.31	.268	0.07
PCL-5	1	0.03	0.03	.857	0.00

Intervention	1	0.22	0.26	.616	0.01
Error	18	0.86			

Table 4.15

Intervention Effects on PTGI Total Scores: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	353.86	3.12	.094	.15
Time * Age	1	0.18	0.00	.968	.00
Time * PCL-5	1	156.30	1.38	.255	.07
Time * Intervention	1	267.53	2.36	.142	.12
Error (Time)	18	113.29			
Tests of Between-Subjects Effects					
Intercept	1	7399.25	6.59	.019	.27
Age	1	71.30	0.06	.804	.00
PCL-5	1	2072.36	1.85	.191	.09
Intervention	1	968.37	0.86	.365	.05
Error	18	1122.99			

Intervention Effects on Subjective Cognition

Two-way mixed ANCOVAs were used to analyze intervention effects on attentional control and EF. Table 4.16 illustrates the non-significant interactions for ACS total scores. Table 4.17 demonstrates a significant interaction between time and intervention for EFI total scores (F (1, 18) = 4.46, p = .049), with ηp^2 = .20. Pairwise comparisons indicated that waitlist participants' EFI scores significantly decreased from pre-to post-intervention, p = .042, while yoga participants' EFI scores non-significantly increased over time.

Table 4.16

Intervention Effects on ACS Total Scores: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	34.16	1.11	.306	.06
Time * Age	1	122.67	3.99	.061	.18
Time * PCL-5	1	31.19	1.01	.328	.05
Time * Intervention	1	0.57	0.02	.894	.00
Error (Time)	18	30.78			
Tests of Between-Subjects Effects					
Intercept	1	7859.56	45.84	.000	.72

Age	1	4.41	0.03	.874	.00
PCL-5	1	192.27	1.12	.304	.06
Intervention	1	5.26	0.03	.863	.00
Error	18	171.46			

Table 4.17

Intervention Effects on EFI Total Scores: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	64.84	5.11	.036	.22
Time * Age	1	6.57	0.52	.481	.03
Time * PCL-5	1	73.07	5.75	.027	.24
Time * Intervention	1	56.57	4.46	.049	.20
Error (Time)	18	12.70			
Tests of Between-Subjects Effects					
Intercept	1	29287.58	107.51	.000	.86
Age	1	72.28	0.27	.613	.01
PCL-5	1	20.88	0.08	.785	.00
Intervention	1	37.11	0.14	.716	.01
Error	18	272.42			

Intervention Effects on Objective Cognition

Two-way mixed ANCOVAs were used to evaluate intervention effects on RT-IIV. Non-significant interactions were found for the ISD on: the N-Back task, Go/No-Go task, and incongruent Flanker trials (see Tables 4.18 through 4.21). For MCC on the N-Back task, there was a significant interaction between time and intervention (F (1, 13) = 5.71, p = .033), with ηp² = .31. Pairwise comparisons revealed a significant increase in yoga participants' MCC scores from pre- to post-intervention, p = .011, and no significant change for waitlist participants.

Table 4.18

Intervention Effects on ISD on the N-Back Task: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	12.77	2.05	.176	.14
Time * Age	1	1.63	0.26	.618	.02
Time * PCL-5	1	5.98	0.96	.345	.07
Time * Intervention	1	0.79	0.13	.728	.01
Error (Time)	13	6.24			

Tests of Between-Subjects Effects					
Intercept	1	344.18	17.60	.001	.58
Age	1	52.26	2.67	.126	.17
PCL-5	1	1.93	0.10	.758	.01
Intervention	1	0.05	0.00	.959	.00
Error	13	19.56			

Table 4.19

Intervention Effects on ISD on the Go/No-Go Task: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	0.21	0.03	.870	.00
Time * Age	1	2.95	0.39	.542	.03
Time * PCL-5	1	1.86	0.25	.627	.02
Time * Intervention	1	9.65	1.28	.278	.09
Error (Time)	13	7.52			
Tests of Between-Subjects Effects					
Intercept	1	115.47	3.10	.102	.19
Age	1	0.06	0.00	.967	.00
PCL-5	1	12.66	0.34	.570	.03
Intervention	1	0.96	0.03	.875	.00
Error	13	37.24			

Table 4.20

Intervention Effects on ISD on Incongruent Flanker Trials: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²
Tests of Within-Subject Effects					
Time	1	0.07	0.06	.817	.00
Time * Age	1	2.46	1.99	.182	.13
Time * PCL-5	1	4.44	3.59	.081	.22
Time * Intervention	1	0.60	0.48	.500	.04
Error (Time)	13	1.24			
Tests of Between-Subjects Effects					
Intercept	1	76.92	4.46	.055	.26
Age	1	26.38	1.53	.238	.11
PCL-5	1	0.63	0.04	.851	.00
Intervention	1	0.07	0.00	.951	.00
Error	13	17.26			

Table 4.21

Intervention Effects on MCC on the N-Back Task: ANCOVA Results

	df	*MS*	*F*	*p*	ηp²

Tests of Within-Subject Effects					
Time	1	1.867 E-6	0.00	.984	.00
Time * Age	1	0.00	0.06	.807	.00
Time * PCL-5	1	0.00	0.94	.350	.07
Time * Intervention	1	0.02	5.71	.033	.31
Error (Time)	13	0.00			
Tests of Between-Subjects Effects					
Intercept	1	1.14	106.04	.000	.89
Age	1	1.442 E-7	0.00	.997	.00
PCL-5	1	0.01	0.97	.344	.07
Intervention	1	0.00	0.40	.538	.03
Error	13	0.01			

Secondary Analyses

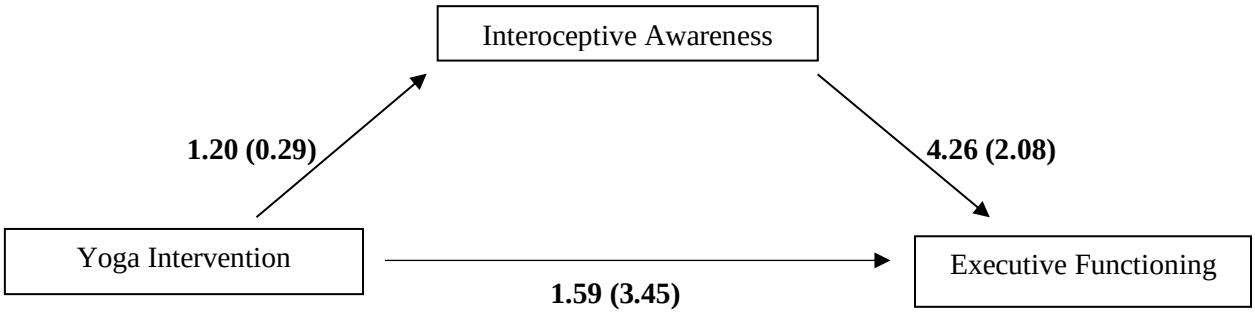
Mediation Analysis

A simple mediation analysis was conducted to examine the mediating role of interoceptive awareness (i.e., post-intervention MAIA trusting score) in the relationship between intervention group and self-reported EF (i.e., post-intervention EFI total score). The MAIA Trusting score was selected as a measure of interoceptive awareness in the absence of a total MAIA score; relative to other MAIA scales, Trusting showed the largest effect size in the analyses of intervention effects, as well as the strongest correlation with EFI total scores at post-intervention (r = .72, p < .001). Covariates in all regression models were age and pre-intervention scores on the PCL-5, EFI, and MAIA Trusting scale. The following steps were taken, guided by Baron and Kenny's (1986) approach to mediation. First, intervention group significantly predicted post-intervention EFI scores, t = 2.56, p = .021. Second, intervention group was a significant predictor of post-intervention MAIA Trusting scores, t = 4.18, p = .001. Third, a partial mediation was revealed: the intervention effect on post-intervention EFI scores was reduced and no longer significant, t = 0.46, p = .652, with the addition of the marginally significant mediator, t = 2.05, p = .058. Sobel's test of the mediation effect was marginally

significant, $z = 1.84$, $p = .065$. The mediation is depicted in Figure 4.2, with unstandardized regression coefficients and standard errors for each step or path.

Figure 4.02

Interoceptive Awareness Partially Mediates the Effect of Yoga on Executive Functioning



Reliable and Clinically Significant Change

With respect to clinically meaningful change in mental health, participants' scores were examined individually, as in a series of *n*=1 case studies (e.g., Zahra & Hedge, 2010). Participants who demonstrated a reliable change score established in the literature for a given measure, were deemed to experience either reliable improvement or worsening. Participants who met this reliable change score *and* also crossed the threshold from clinically significant to subthreshold, or vice versa, were said to additionally show either clinically significant improvement or worsening. Table 4.22 presents the number of participants showing change in PTSD, depression, and generalized anxiety, and quantifies change in terms of number of points. The results presented below are inclusive of study and program attrition. Of the three yoga participants who did not complete post-intervention testing, two participants reported clinically significant depression and PTSD at baseline, one of whom withdrew from the yoga program due to occupational stress and mental health symptoms. As well, the waitlist participant with study attrition reported clinically significant depression and PTSD at baseline.

Baseline Mental Health and Improvement.

PTSD. Three yoga participants and seven waitlist participants met clinical threshold for PTSD symptoms on the PCL-5 at baseline. As per Weathers and colleagues (2013), change of ≥ 5 points was considered reliable; change was clinically significant if it additionally crossed the threshold of 33 points. Five yoga participants reliably improved, including one who clinically improved. Four waitlist participants reliably improved, two of whom also clinically improved.

***Depression*.** Seven yoga participants and ten waitlist participants indicated clinically significant baseline depressive symptoms on the PHQ-9. Reliable change on this measure is ≥ 5 points (Löwe et al., 2004), and clinical change crossed the threshold of 10 points (e.g., Manea et al., 2012). Two yoga participants evidenced clinical improvement.

***Generalized Anxiety*.** At baseline, two yoga participants and eight waitlist participants endorsed clinically significant anxiety symptoms on the GAD-7. This measure has a reliable change index of 6 (Bischoff et al., 2020); clinical change crossed the threshold of 10 points (e.g., Spitzer et al., 2006). One yoga participant and one waitlist participant clinically improved.

Worsening Mental Health. One yoga participant clinically worsened on measures of PTSD and generalized anxiety, and another yoga participant reliably worsened on all mental health measures. One waitlist participant demonstrated clinical worsening of PTSD, and another waitlist participant showed reliable worsening of generalized anxiety.

Table 4.22

Number of Participants showing Reliable and Clinically Significant Change by Group and with Point-Value of Change

	Yoga (*N* = 10)				Waitlist (*N* = 12)			
	Improvement		Worsening		Improvement		Worsening	
Measure	Reliable	Clinical	Reliable	Clinical	Reliable	Clinical	Reliable	Clinical
PCL-5	*n* = 4 *5 – 11 points*	*n* = 1 *17 points*	*n* = 1 *20 points*	*n* = 1 *28 points*	*n* = 2 *5 – 7 points*	*n* = 2 *10 – 18 points*		*n* = 1 *14 points*

PHQ-9	*n* = 2 *7 – 8.5 points*	*n* = 1 *6 points*			
GAD-7	*n* = 1 *6 points*	*n* = 1 *6 points*	*n* = 1 *10 points*	*n* = 1 *12 points*	*n* = 1 *7 points*

Discussion

Interpreting Mental Health Effects

This initial RCT examined the effectiveness of TIME yoga for improving aspects of psychological and cognitive functioning integral to CCT survivors' self-regulation during the COVID-19 pandemic. The intervention was delivered to a non-clinical community sample comprised primarily of undergraduate students. With respect to mental health, the yoga intervention was effective for improving symptoms of depression, specifically for participants with higher levels of PTSD symptoms. Due to small sample size and upper range restriction for yoga participants, higher PTSD scores were determined based on a mean cut-score rather than clinical threshold. Still, the results suggest that CCT survivors presenting with depression and co-morbid subclinical to mild PTSD symptomology might benefit from TIME yoga, and future studies should investigate this further.

One explanation for this finding is that individuals with co-morbid symptomology may present with greater opportunity for distress-reduction. Also, the TIME yoga intervention is designed to target trauma-related distress. It follows then, that the intervention would help to alleviate depressive symptoms associated with underlying trauma, as opposed to depression precipitated by other circumstances, such as may occur in CCT survivors who were coping well until the onset of the pandemic. Indeed, Flory and Yehuda (2015) discuss evidence that survivors of physical and sexual abuse are particularly vulnerable for developing a “trauma-related phenotype” of co-occurring major depressive disorder (MDD) and PTSD, which is associated

with shared neurobiological and genetic features. This is in contrast to standalone iterations of PTSD and MDD, including MDD related to emotional neglect and psychological abuse. While TIME yoga did attempt to reach these latter types of ACEs, a yoga intervention for non-trauma standalone MDD would differ from TIME yoga in theoretical rationale and content. Overall, reduction of co-morbid depressive symptoms positions TIME yoga as a compelling front-line intervention for alleviating depressive symptoms, which can potentially enable better engagement and adherence to trauma-focused and talk-based treatments (e.g., Flory & Yehuda, 2015). This is an important benefit of the program as co-occurring PTSD and depression is prevalent among CCT survivors, and this occurs in approximately half of the population more generally. Further, this diverges from a previous trial of an adjunctive trauma-sensitive yoga program for complex and comorbid PTSD (e.g., Nguyen-Feng et al., 2020; van der Kolk et al., 2014), which focused on benefits for PTSD symptomology rather than co-occurring depression. Contrary to the findings regarding depression, there were no significant intervention effects on PTSD symptoms or generalized anxiety symptoms. When interpreting the intervention effects, it is important to consider that despite random assignment, there were higher baseline rates of clinically significant mental health symptoms in the waitlist group relative to the yoga group. Interestingly, the groups were especially discrepant in PTSD and generalized anxiety symptoms, which were the two symptom clusters statistically unaffected by the intervention, and similarly affected across groups in terms of clinically meaningful improvement; factors such as floor and ceiling effects, as well as regression toward the mean, may have inhibited detection of differential change in the respective yoga and waitlist groups. As PTSD symptom scores statistically differed between groups at baseline, the results must be considered in light of the

waitlist group displaying greater post-traumatic distress than the yoga group; this was an uncontrollable limitation of the study.

The results must also be interpreted with the caveat that, though many benefits were observed for yoga participants, yoga is not a risk-free intervention. Clinical and reliable worsening of mental health was also observed in two participants in each of the yoga and waitlist groups, or 15% of the sample. Given the decline in both groups, it is unclear whether the yoga per se led to adverse effects, or whether the worsening might have been triggered by factors external to the intervention. Still, deteriorating mental health can be part of contemplative practices initially, particularly for practitioners with trauma histories, as practitioners are encouraged to pay attention to thoughts, emotions, and sensations that may be outside of their window of tolerance (Van Dam et al., 2018). Given the non-linear path of progress, the brief length of the yoga series and lack of assigned post-intervention practice may be considered limitations – despite benefits for administration and adherence – as practitioners might not have an opportunity to recover from early-on exacerbation of symptoms. As discussed in Chapter 3, TIME yoga is considered a relatively safe intervention; no adverse events relating to substance abuse, psychosis, self-harm, or suicidality were reported among yoga participants; however, these reports may have been biased by demand characteristics and social desirability, and also do not capture undesired changes in one's life such as relational and occupational functioning. Moreover, relative to the window of tolerance framework, the measures of adversity and deterioration in this study may not reflect the "defensive accommodations" (i.e., Kain & Terrell, 2018b) that survivors may engage in to stabilize themselves while in zones of hyper- or hypo-arousal, or while adjusting to the potential novelty of being within one's optimal arousal zone

(e.g., compulsive eating or dissociation as a method of self-soothing in cases of extreme hyper-arousal; stimulant use or hyper-sexuality to increase energy in cases of extreme hypo-arousal).

Emotional and Interoceptive Functioning

Yoga participants in the present study also demonstrated increased interoceptive awareness on several scales of the MAIA (i.e., Trusting, Self-Regulation, Attention Regulation, Body Listening), the latter three of which demonstrated the largest effect sizes in a study of contemplative training (i.e., body scan and breath meditation; Borneman et al., 2015), and also shifted in a case series study of trauma-sensitive yoga (Neukirch et al., 2019). This represents a TIME yoga intervention validity check in the sense that mind-body practices are expected to improve interoceptive awareness and relatedly, mindfulness (e.g., Borneman et al., 2015; Mehling et al., 2017). It also may be a fundamental mechanism by which yoga can improve trauma-related symptomology and enable individuals to benefit from treatments such as prolonged exposure therapy (Neukirch et al., 2019). Further, the concurrent changes in interoceptive awareness and EF, which are described in more detail below, position TIME yoga as a promising method of activating the central executive network and enabling the survivor to engage in emotion regulation and top-down reappraisal of traumatic memories (e.g., Harricharan et al., 2020). Thus, in the ISTSS's multi-step model of treating complex PTSD, TIME yoga might be ideally suited to the initial stabilization phase, as described in Chapter 3. The Noticing and Emotional Awareness scale scores, which represent the subjective ability to accurately perceive one's bodily states, including in the context of changing emotions, were surprisingly unaffected by the aforementioned TSY intervention, or the current intervention. These two MAIA scales had the highest baseline scores in the current sample; perhaps these more basic forms of awareness were already developed or were even heightened during the COVID-19

pandemic which has promoted hypervigilance to one's body. The yoga program likely complemented these existing awareness skills by fostering metacognitive awareness, or the skills to step back and observe sensations without judgment. The program encouraged participants to deliberately and non-judgmentally direct attention to their bodies, and to use bodily awareness to understand and regulate their emotions and behaviours, and eventually, to feel safe and at home in their bodies. In other words, TIME yoga helped participants to cultivate the higher-level regulatory elements of interoceptive awareness, and to trust their body as a regulatory resource (e.g., Borneman et al., 2015). Moreover, the intervention apparently protected participants from the decline in many interoceptive abilities that was evidenced among waitlist participants (i.e., for Trusting, Self-Regulation, Attention Regulation, and Not-Distracting). It seems that in the midst of the pandemic, the waitlist participants maintained Noticing and Emotional Awareness abilities, but struggled with keeping their regulatory abilities and sense of safety online, and resorted to distracting themselves from uncomfortable sensations.

Considering that TIME yoga directly cultivates awareness of bodily sensations rather than identification and modulation of concurrent emotions, it is understandable that changes were observed in interoception rather than emotional suppression and alexithymia. The null finding regarding emotional suppression is somewhat in keeping with the mindfulness literature; One study reported changes in anger suppression after MBSR (Robins et al., 2012), another study found that mindfulness and emotional suppression strategies predicted unique variance in emotional well-being (Brockman et al., 2017), and a neurobiological study found that while mindful and suppressive approaches to emotion regulation both regulate the amygdala in a top-down fashion, the former engages subcortical connections with the medial prefrontal cortex, while the latter employs dorsolateral prefrontal connections (Murakami et al., 2015). Taken

together, this might mean that emotional suppression is not altered by mindful awareness alone, but perhaps is impacted by another element of MBSR. Indeed, Iani and colleagues (2019) explain that verbal description of emotions is the mindfulness factor most crucial for emotional suppression. Unfortunately, TIME yoga did not impact alexithymia. Shifts in alexithymia do occur after mindfulness-based interventions (MBIs; Norman et al., 2019), and have been attributed to two practice elements: (1) presence, which is related to interoceptive changes; and (2) loving kindness towards difficult emotions, which reflects some other mechanism of change (Borneman et al., 2017). Relative to TIME yoga, it seems that MBIs enhance the abilities to identify and communicate emotions by cultivating greater awareness of emotional experience alongside physical sensations, as well as self-compassion towards emotional aspects of oneself.

Cognitive Effects of TIME Yoga

Objective Cognition

One cognitive outcome impacted by yoga in the study was objective EF accuracy on the N-Back working memory task. This finding builds on previous work by Cochrane and colleagues (2018), which found a main effect of an open monitoring mindfulness intervention, versus a cognitive restructuring intervention, on the same N-Back accuracy index. The N-Back is intended to be a cognitively demanding working memory task, and indeed participants in the current sample perceived it as the most difficult and tiring of the executive task battery. EF was among the cognitive outcomes with the largest effect sizes in Gothe and colleagues' (2015) meta-analysis of the impact of yoga on cognition, which may be attributed to psychophysiological arousal changes and bottom-up stimulation of vagal afferents as participants expand their repertoire of movement and breathing techniques. As well, Whitfield and colleagues' (2021) meta-analysis of cognitive outcomes of MBIs versus comparators revealed

strong evidence of effects only for EF and working memory; this has been related to the mindfulness practice requirements for repeated attentional engagement, disengagement, maintenance, and monitoring, which are conceivably also processes recruited while navigating yogic asana and pranayama sequences.

Contrary to hypotheses that cognitive RT-IIV would decrease among yoga participants, as a marker of enhanced self-regulation, no intervention effects were observed for this outcome. As discussed in Chapter 3, IIV is a marker of compromised neural integrity, which perhaps was not sufficiently elevated in this non-psychiatric and non-neurological community sample which consisted primarily of undergraduate students. The sample was exclusive of individuals with severe mental illness, and on average, the sample displayed subclinical PTSD symptoms, moderate levels of depressive symptoms, and mild anxiety levels – which may have been triggered by recent pandemic-related events, rather than associated with enduring mental illness associated with structural changes in the brain. In a sample of HIV+ adults, RT-IIV on the N-back task was related to ACEs and to total grey and white matter volumes, independent of PTSD, depression, or stress (Clark et al., 2018); however, this association may be specific to this HIV+ sample. In addition to participants potentially not possessing an IIV-related neural profile at baseline, they may have received an insufficient dose of self-regulatory practice within the four-week yoga series, for the purposes of altering brain structure and function and consequently changing IIV. Eight-week MBIs have been shown to produce improvements in RT-IIV for healthy older adults and those with subjective cognitive decline on an executive attention (Go/No-Go) task (Smart et al., 2016), as well as for healthy meditation novices on a sustained attention task (Jensen et al., 2012). The findings from this yoga study diverge from the mindfulness literature and may suggest mechanistic differences between the two contemplative

practices. The initial stages of mindfulness training emphasize focused attention mindfulness (Lutz et al., 2008) associated with prefrontal cortex function, which might be more sensitive to IIV. Conversely, yoga, with its focus on the body, may be more akin to open monitoring mindfulness, which is more associated with right hemisphere structures and insular cortex activation (Fox, Nijeboer et al., 2014; Fox, Dixon, et al., 2016). This would make sense given the aforementioned working memory findings that were similar following yoga and open monitoring mindfulness (Cochrane et al., 2018).

Subjective Cognition

In terms of self-reported EF, at baseline, EFI scores in the current well-educated sample were somewhat higher than in Spinella's (2005) community validation sample. Over the course of the intervention, EFI scores significantly decreased for waitlist participants and simultaneously non-significantly increased for yoga participants. ACS scores did not shift; notably, this measure is based on Posner and colleagues' model of dual posterior and anterior attentional systems that support involuntary and voluntary attentional functions (Derryberry & Reed, 2002). The anterior system amalgamates frontal regions and primarily focuses on the anterior cingulate cortex (ACC) and its connections with subcortical limbic systems. This model of executive attention neglects the more nuanced frontal substrates of items included on the EFI, including dorsolateral, orbitofrontal, and medial prefrontal circuits (Spinella, 2005), the latter of which is most commonly implicated in the traumatic stress response. Thus, it is sensible that the EFI would detect changes in subjective cognition among CCT survivors. EF changes in the context of null attention findings are consistent with recent studies suggesting that the yoga element of MBIs does not enhance attention regulation above and beyond mindfulness practices (Wimmer et al., 2020), and that mindful yoga may promote long-term changes in EF but not

attention (Mak et al., 2020), whereas MBIs are notorious for improving various aspects of attention (Chiesa et al., 2011), with recent meta-analytic evidence suggesting that MBIs implicate attentional regulation – which overlap with EF, and conceivably are captured by self-reported day-to-day functioning on the ACS – rather than basic attentional processes such as those measured by continuous performance tasks (Whitfield et al., 2021). Taken together, the evidence for change on the EFI and lack thereof on the ACS might pinpoint specific differences in yoga versus mindfulness practices. For instance, yogic practices may lean towards the open monitoring form of awareness rather than the focused attention training that is prominent in mindfulness practices, at least for novices (e.g., Chiesa et al., 2011). Further, explicit attention training in MBIs possibly bolsters practitioners' self-efficacy and consequently their self-reported and objective attentional performance, whereas yoga is typically presented as a physical rather than attentional practice. Indeed, EF changes could reflect the yogic focus on training interoceptive awareness – which, as children and adolescents age, is increasingly associated with activation in multiple frontal regions, including the ACC, orbitofrontal cortex, and mid-inferior frontal gyri (Klabunde et al., 2019).

Interoception as a Mediator of Cognitive Change

Interestingly, interoceptive awareness actually mediated improvements in subjective EF in the current study. This mediation model parallels and supports Thayer's (2009) neurovisceral integration model, in which EF can be modulated by bottom-up pathways between the vagus nerve and the prefrontal cortex. Moreover, changes in interoceptive inference at the level of the insula are a crucial step in the bottom-up pathway whereby sensory information is transmitted from the brain stem to cortical areas, ultimately promoting multi-sensory integration and embodiment (Harricharan et al., 2020). It is particularly compelling that the ability to trust and

feel safe and at home in one's body was the mediating factor in this pathway. This finding is akin to Damasio's infamous demonstration that patients with ventromedial prefrontal lesions, who were unable to listen to and rely on awareness of their bodily sensations, (i.e., "gut feelings") struggled to make adaptive decisions in a gambling task (e.g., Damasio, 2000). Perhaps in the current study, participants' abilities to trust their intuition led to increases in self-efficacy, empowering them to make lifestyle changes that were apparent on an ecologically valid self-report measure of EF, as opposed to on an objective EF task index. Although self-compassion was not directly assessed in this study, yogic ethical guidelines and the emphasis on developing inner resources in TIME yoga may implicate self-compassion in the pathway between interoceptive awareness and promoting adaptive planning and decision-making in everyday life. Of course, it is likely that elements of interoceptive awareness other than trusting, contributed to self-regulation improvements. The specificity of mediating factors in this small sample was limited by the multidimensional nature of interoceptive awareness; more extensive studies may examine the role of other MAIA scales in EF enhancement.

Limitations and Future Directions

Due to restrictions on in-person research during the COVID-19 pandemic, it was not possible to collect psychophysiological data. Replication studies of TIME yoga ought to measure heart rate variability (HRV) and investigate its role in improved self-reported and objective EF; along with ACC activity, HRV has been shown to increase with mindfulness-based interventions, and potentially mediate improvements in EF (Tang et al., 2012). Assessment of HRV may serve as an empirical test of: (1) vagal control and the inhibition of the default stress response as per the GUTS model (Brosschot et al., 2017), which may additionally be indexed by enhanced fear inhibition among survivors of cumulative interpersonal trauma (Huskey et al.,

2022); (2) emotion regulation and associated limbic regions such as the ventromedial prefrontal cortex, ACC, and amygdala (Mather & Thayer, 2018); and (3) whether the window of tolerance has been widened with yoga practice. Inclusion of standardized neuropsychological measures in future replication studies is also recommended. Trauma survivors typically score within normal limits on these tests (K. Silveira et al., 2020), and the question remains as to whether changes in survivors' functioning can be observed on clinical neuropsychological measures with contemplative practices such as yoga.

As well, the current study was limited by smaller sample size. Future studies with larger samples may use multi-level modelling statistical methods to better decompose the three-way interaction observed between time, intervention, and PTSD symptoms for the outcome of depression. Further, questions such as "Does yoga dose (i.e., number of sessions) moderate treatment outcome?" can be addressed. If there is sufficient variation in ACE types, diverging psychological and cognitive outcomes for abuse versus neglect can also be examined. Additionally, maintenance of benefits is a common concern following MBIs, and studies that include follow-up assessment intervals are encouraged.

Another important direction concerns the convergence and divergence evidenced between TIME yoga outcomes and those of MBIs; that is, trait mindfulness should be measured (e.g., by the Five Facet Mindfulness Questionnaire) in order to assess which aspects of mindfulness, if any, might be fostered by the yoga practices. Ongoing TIME yoga development will incorporate more explicit focus on identifying and soothing present-moment emotions, in order to target changes in alexithymia, emotion suppression, and ultimately, emotional dysregulation – a transdiagnostic feature of psychopathology that can be acted upon to lead to farther reaching improvements in mental health.

Critically, an examination of improvement – or exacerbation – of dissociative symptoms will enrich observations of treatment effectiveness and safety. Dissociative symptoms are especially relevant to CCT survivors who may have developed adaptations of depersonalization and derealization in order to cope with inescapable trauma within their homes. The current study did not assess these symptoms in the current community sample; this is a major study limitation, especially considering that this sample possessed moderate level of depressive symptoms, which may share behavioural and neurobiological features with depression, including emotional numbness (Feeny et al., 2000) and altered default mode network activity (Zhu et al., 2012). Still, the current results suggest interoceptive mechanisms by which TIME yoga may improve dissociation. Specifically, improvement in interoceptive awareness may benefit survivors with dissociative symptoms who present with hyposensitivity to sensory experiences and overmodulation of amygdala activity (Harricharan et al., 2021). Further, given that interoceptive awareness mediated improvements in EF, it is plausible that TIME yoga may increase functional connectivity between the insula and dorsolateral prefrontal cortex, which is known to be reduced in survivors with PTSD and its dissociative subtype. Overall, TIME yoga shows promise for enhancing embodiment among survivors with dissociative symptoms, and this should be examined further.

Finally, though this trial was limited by the practicalities and psychological confounds of collecting data during the pandemic, its effectiveness for enhancing multiple indices of self-regulation among trauma survivors during this health crisis indicates a need to investigate a new application of TIME yoga: for individuals struggling with “long COVID”. The lasting post-infectious symptoms associated with long COVID bear striking resemblance to chronic effects of

trauma, including altered respiratory functioning, fatigue, cognitive impairment, sleep disruption, post-traumatic stress, and anxiety (e.g., Crook et al., 2021).

Conclusion

In this RCT, the brief TIME yoga intervention effectively improved self-regulation among CCT survivors during the COVID-19 pandemic, across domains of psychological (i.e., depressive symptoms), emotional (i.e., interoceptive awareness), and executive (i.e., subjective and objective) functioning. Further, the study affirms bottom-up pathways by which yoga-related improvements in bodily awareness can mediate enhanced executive control. Future studies are encouraged to continue to investigate the body-to-brain pathway by which yoga can help trauma survivors to harness the power of their own self-regulation.

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Appendix A
Questionnaires

The following questionnaires are included in this appendix, each of which is associated with published, peer-reviewed articles (source articles available on request):

1. Traumatic Antecedents Questionnaire (TAQ; Luxenberg, Spinazzola, & van der Kolk, 2001)
2. Life Events Checklist for DSM-5 (LEC-5; Weathers et al., 2013)
3. PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013)
4. Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001)
5. Generalized Anxiety Disorder 7-item scale (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006)
6. Emotion Regulation Questionnaire (ERQ; Gross & John, 2003)
7. Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012)
8. Toronto Alexithymia Scale (TAS-20; Bagby, Parker, & Taylor, 1994)
9. Attentional Control Scale (ACS; Derryberry & Reed, 2002)
10. Executive Function Index (EFI; Spinella, 2005)
11. Brief Resilience Scale (BRS; Smith et al., 2008)
12. Posttraumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996)
13. Demographic and Lifestyle Questionnaire (Unpublished measure)
14. COVID-19 Experiences Questionnaire (Unpublished measure)
15. Recent Experiences Questionnaire (Unpublished measure)
16. Weekly Check-in Email (Unpublished measure)

TAQ

This questionnaire asks you to describe experiences you may have had as a young child (ages 0 to 6), as a school age child (ages 7-12), as an adolescent (ages 13-18), and as an adult. For each item, indicate the degree to which the statement describes your experience at each different age period. The scale has both frequency and intensity words; please choose the highest applicable number. If there are any age periods for an item that you are unable to answer, please indicate this by choosing DK ("don't know").

For Each Question and Age Group all Use the Highest Applicable Number:

0= never or not at
1= rarely or a little bit
2= occasionally or moderately 3= often or very much
DK= don't know

1. I generally feel safe and cared for.

0-6	7-12	13-18	Adult
1	1	1	1
2	2	2	2
3	3	3	3
DK	DK	DK	DK

2. Someone made sure I got up in the morning and went to school.

0-6	7-12	13-18	Adult
1	1	1	1
2	2	2	2
3	3	3	3
DK	DK	DK	DK

3. I was really good at something (like sports, a hobby, school, work, or some creative activity).

0-6	7-12	13-18	Adult
1	1	1	1
2	2	2	2
3	3	3	3
DK	DK	DK	DK

4. I had good friends.

0-6	7-12	13-18	Adult
1	1	1	1
2	2	2	2
3	3	3	3
DK	DK	DK	DK

5. I felt close to at least one of my brothers or sisters.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

6. Somebody in my family had so many problems that there was little left for me.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

7. I felt that nobody cared whether I lived or died.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

8. I had someone to talk with outside my family when something was bugging me at home.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

9. My parents confided things in me that made me feel uncomfortable.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

10. My parents were divorced or separated.

0-6	No	7-12	No	13-18	No	Adult	No
	Yes		Yes		Yes		Yes

11. I lived with different people at different times (like different relatives or foster families).

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

12. Somebody close to me died.

0-6	No	7-12	No	13-18	No	Adult	No
	Yes		Yes		Yes		Yes

13. I had a serious illness and/or had to be hospitalized for a medical problem.

0-6	1	7-12	1	13-18	1	Adult	1

2	2	2	2
3	3	3	3
DK	DK	DK	DK

14. Someone I was close to was very sick, or in an accident for which they needed to be hospitalized.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

15. I received news that someone close to me had been seriously injured or violently killed during an accident, fight, or a crime.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

16. In my parents' eyes, nothing I did was ever good enough.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

17. People in my family called me insulting names.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

18. The rules in my family were unclear and inconsistent.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

19. The punishments I received were unfair.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

20. My parents hurt each other physically when they argued and fought.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2

3	3	3	3
DK	DK	DK	DK

21. I spent time out of the house and no one knew where I was.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

22. People in my family were out of control.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

23. I witnessed physically violence in my family.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

24. Someone in my family got medical attention because of violence.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

25. Someone in my family had a problem with alcohol and/or drugs.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

26. I abused alcohol and/or drugs.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

27. My caregivers were so into alcohol or drugs that they couldn't take care of me.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2

	3		3		3		3
	DK		DK		DK		DK

28. I was beaten, kicked or punched by someone close to me.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

29. I was in a situation in which I was convinced I would be physically injured or lose my life.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

30. Someone outside my family attacked me.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

31. I saw dead bodies.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

32. I was involved in a serious accident.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

33. I was in a natural disaster.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

34. I saw sexual things that scared me.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

35. Someone (older) touched me sexually against my wishes or tried to make me touch them.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

36. Someone forced me to have sex against my will.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

37. Someone threatened me with physical harm unless I did something sexual.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

38. I believed that one of my brothers or sisters was sexually molested.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

39. I have had another very frightening or traumatic experience where I felt intense fear, helpless, or horrified.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

40. Something terrible happened to me that still remains a mystery to me.

0-6	1	7-12	1	13-18	1	Adult	1
	2		2		2		2
	3		3		3		3
	DK		DK		DK		DK

41. How upsetting was it to answer these questions? Intensity 0
1
2
3
DK

LEC-5

Instructions: Listed below are a number of difficult or stressful things that sometimes happen to people. For each event check one or more of the boxes to the right to indicate that: (a) it happened to you personally; (b) you witnessed it happen to someone else; (c) you learned about it happening to a close family member or close friend; (d) you were exposed to it as part of your job (for example, paramedic, police, military, or other first responder); (e) you're not sure if it fits; or (f) it doesn't apply to you.

Be sure to consider your *entire life* (growing up as well as adulthood) as you go through the list of events.

Event	Happened to me	Witnessed it	Learned about it	Part of my job	Not sure	Doesn't apply
1. Natural disaster (for example, flood, hurricane, tornado, earthquake)						
2. Fire or explosion						
3. Transportation accident (for example, car accident, boat accident, train wreck, plane crash)						
4. Serious accident at work, home, or during recreational activity						
5. Exposure to toxic substance (for example, dangerous chemicals, radiation)						
6. Physical assault (for example, being attacked, hit, slapped, kicked, beaten up)						
7. Assault with a weapon (for example, being shot, stabbed, threatened with a knife, gun, bomb)						
8. Sexual assault (rape, attempted rape, made to perform any type of sexual act through force or threat of harm)						
9. Other unwanted or uncomfortable sexual experience						
10. Combat or exposure to a war-zone (in the military or as a civilian)						
11. Captivity (for example, being kidnapped, abducted, held hostage, prisoner of war)						
12. Life-threatening illness or injury						
13. Severe human suffering						
14. Sudden violent death (for example, homicide, suicide)						
15. Sudden accidental death						
16. Serious injury, harm, or death you caused to someone else						
17. Any other very stressful event or experience						

17a. Please briefly identify the event you are thinking of: _____

If you experienced more than one of the events listed on this page, think about the event that you consider to be the worst event, which for this questionnaire means the event that currently bothers you the most. **If you have experienced only one of the events** listed on this page, use that one as the worst event. Briefly describe the worst event (for example, what happened, who was involved, etc.):

_____

Approximately how old were you when the worst event happened? _____

PCL-5

Instructions: Below is a list of problems that people sometimes have in response to a very stressful experience. Keeping your **worst event** from the previous page in mind, please read each problem carefully and then circle one of the numbers to the right to indicate how much you have been bothered by that problem in the past month.

In the past month, how much were you bothered by:	Not at all	A little bit	Moderately	Quite a bit	Extremely
1. Repeated, disturbing, and unwanted memories of the stressful experience?	0	1	2	3	4
2. Repeated, disturbing dreams of the stressful experience?	0	1	2	3	4
3. Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?	0	1	2	3	4
4. Feeling very upset when something reminded you of the stressful experience?	0	1	2	3	4
5. Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?	0	1	2	3	4
6. Avoiding memories, thoughts, or feelings related to the stressful experience?	0	1	2	3	4
7. Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?	0	1	2	3	4
8. Trouble remembering important parts of the stressful experience?	0	1	2	3	4
9. Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?	0	1	2	3	4
10. Blaming yourself or someone else for the stressful experience or what happened after it?	0	1	2	3	4
11. Having strong negative feelings such as fear, horror, anger, guilt, or shame?	0	1	2	3	4
12. Loss of interest in activities that you used to enjoy?	0	1	2	3	4
13. Feeling distant or cut off from other people?	0	1	2	3	4
14. Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?	0	1	2	3	4
15. Irritable behavior, angry outbursts, or acting aggressively?	0	1	2	3	4
16. Taking too many risks or doing things that could cause you harm?	0	1	2	3	4
17. Being “superalert” or watchful or on guard?	0	1	2	3	4
18. Feeling jumpy or easily startled?	0	1	2	3	4
19. Having difficulty concentrating?	0	1	2	3	4
20. Trouble falling or staying asleep?	0	1	2	3	4

PHQ-9

Over the past 2 weeks, how often have you been bothered by any of the following problems?	Not At all	Several Days	More Than Half the Days	Nearly Every Day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed or hopeless	0	1	2	3
3. Trouble falling asleep, staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself - or that you're a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed. Or, the opposite - being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

GAD-7

Over the last 2 weeks, how often have you been bothered by the following problems?	Not at all sure	Several days	Over half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3
Add the score for each column	+	+	+	
Total Score *(add your column scores)* =				

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all _____
Somewhat difficult _____
Very difficult _____
Extremely difficult _____

ERQ

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

1----------2----------3----------4----------5----------6----------7
strongly disagree neutral strongly agree

1. ____ When I want to feel more *positive* emotion (such as joy or amusement), I *change what I'm thinking about*.
2. ____ I keep my emotions to myself.
3. ____ When I want to feel less *negative* emotion (such as sadness or anger), I *change what I'm thinking about*.
4. ____ When I am feeling *positive* emotions, I am careful not to express them.
5. ____ When I'm faced with a stressful situation, I make myself *think about it* in a way that helps me stay calm.
6. ____ I control my emotions by *not expressing them*.
7. ____ When I want to feel more *positive* emotion, I *change the way I'm thinking* about the situation.
8. ____ I control my emotions by *changing the way I think* about the situation I'm in.
9. ____ When I am feeling *negative* emotions, I make sure not to express them.
10. ___ When I want to feel less *negative* emotion, I *change the way I'm thinking* about the situation.

MAIA

Below you will find a list of statements. Please indicate how often each statement applies to you generally in daily life.

.	Circle one number on each line					
	Never					Always
1. When I am tense I notice where the tension is located in my body.	0	1	2	3	4	5
2. I notice when I am uncomfortable in my body.	0	1	2	3	4	5
3. I notice where in my body I am comfortable.	0	1	2	3	4	5
4. I notice changes in my breathing, such as whether it slows down or speeds up.	0	1	2	3	4	5
5. I do not notice (I ignore) physical tension or discomfort until they become more severe.	0	1	2	3	4	5
6. I distract myself from sensations of discomfort.	0	1	2	3	4	5
7. When I feel pain or discomfort, I try to power through it.	0	1	2	3	4	5
8. When I feel physical pain, I become upset.	0	1	2	3	4	5
9. I start to worry that something is wrong if I feel any discomfort.	0	1	2	3	4	5
10. I can notice an unpleasant body sensation without worrying about it.	0	1	2	3	4	5
11. I can pay attention to my breath without being distracted by things happening around me.	0	1	2	3	4	5
12. I can maintain awareness of my inner bodily sensations even when there is a lot going on around me.	0	1	2	3	4	5
13. When I am in conversation with someone, I can pay attention to my posture.	0	1	2	3	4	5
14. I can return awareness to my body if I am distracted.	0	1	2	3	4	5
15. I can refocus my attention from thinking to sensing my body.	0	1	2	3	4	5
16. I can maintain awareness of my whole body even when a part of me is in pain or discomfort.	0	1	2	3	4	5

Please indicate how often each statement applies to you generally in daily life.

	Circle one number on each line					
	Never					**Always**
17. I am able to consciously focus on my body as a whole.	0	1	2	3	4	5
18. I notice how my body changes when I am angry.	0	1	2	3	4	5
19. When something is wrong in my life I can feel it in my body.	0	1	2	3	4	5
20. I notice that my body feels different after a peaceful experience.	0	1	2	3	4	5
21. I notice that my breathing becomes free and easy when I feel comfortable.	0	1	2	3	4	5
22. I notice how my body changes when I feel happy / joyful.	0	1	2	3	4	5
23. When I feel overwhelmed I can find a calm place inside.	0	1	2	3	4	5
24. When I bring awareness to my body I feel a sense of calm.	0	1	2	3	4	5
25. I can use my breath to reduce tension.	0	1	2	3	4	5
26. When I am caught up in thoughts, I can calm my mind by focusing on my body/breathing.	0	1	2	3	4	5
27. I listen for information from my body about my emotional state.	0	1	2	3	4	5
28. When I am upset, I take time to explore how my body feels.	0	1	2	3	4	5
29. I listen to my body to inform me about what to do.	0	1	2	3	4	5
30. I am at home in my body.	0	1	2	3	4	5
31. I feel my body is a safe place.	0	1	2	3	4	5
32. I trust my body sensations.	0	1	2	3	4	5

TAS-20

Using the scale provided as a guide, indicate how much you agree or disagree with each of the following statements by circling the corresponding number. Give only one answer for each statement.

1	2	3	4	5
Strongly Disagree	Moderately Disagree	Neither Disagree Nor Agree	Moderately Agree	Strongly Agree

1. I am often confused about what emotion I am feeling. _____
2. It is difficult for me to find the right words for my feelings. _____
3. I have physical sensations that even doctors don't understand. _____
4. I am able to describe my feelings easily. _____
5. I prefer to analyze problems rather than just describe them. _____
6. When I am upset, I don't know if I am sad, frightened, or angry.
7. I am often puzzled by sensations in my body. _____
8. I prefer to just let things happen rather than to understand why they turned out that way._____
9. I have feelings that I can't quite identify. _____
10. Being in touch with emotions is essential. _____
11. I find it hard to describe how I feel about people. _____
12. People tell me to describe my feelings more. _____
13. I don't know what's going on inside me. _____
14. I often don't know why I am angry. _____
15. I prefer talking to people about their daily activities rather than their feelings. _____
16. I prefer to watch "light" entertainment shows rather than psychological dramas. _____
17. It is difficult for me to reveal my innermost feelings, even to close friends. _____
18. I can feel close to someone, even in moments of silence. _____
19. I find examination of my feelings useful in solving personal problems. _____
20. Looking for hidden meanings in movies or plays distracts from their enjoyment. _____

ACS

1	2	3	4
almost never	sometimes	often	always

1. It's very hard for me to concentrate on a difficult task when there are noises around. _____
2. When I need to concentrate and solve a problem, I have trouble focusing my attention. _____
3. When I am working hard on something, I still get distracted by events around me. _____
4. My concentration is good even if there is music in the room around me. _____
5. When concentrating, I can focus my attention so that I become unaware of what's going on around me. _____
6. When I am reading or studying, I am easily distracted if there are people talking in the same room. _____
7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts. _____
8. I have a hard time concentrating when I'm excited about something. _____
9. When concentrating I ignore feelings of hunger or thirst. _____
10. I can quickly switch from one task to another. _____
11. It takes me a while to get really involved in a new task. _____
12. It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures. _____
13. I can become interested in a new topic very quickly when I need to. _____
14. It is easy for me to read or write while I'm also talking on the phone. _____
15. I have trouble carrying on two conversations at once. _____
16. I have a hard time coming up with new ideas quickly. _____
17. After being interrupted or distracted, I can easily shift my attention back to what I was doing before. _____
18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it. _____
19. It is easy for me to alternate between two different tasks. _____
20. It is hard for me to break from one way of thinking about something and look at it from another point of view. _____

EFI

Rate how well each of the following statements describes you.

1 = Not at all, 3 = Somewhat, 5 = Very much

1. I have a lot of enthusiasm to do things. 1 2 3 4 5
2. When doing several things in a row, I mix up the sequence 1 2 3 4 5
3. I try to plan for the future 1 2 3 4 5
4. I can sit and do nothing for hours. 1 2 3 4 5
5. I take risks, sometimes for fun. 1 2 3 4 5
6. I have trouble when doing two things at once, multi-tasking 1 2 3 4 5
7. I'm interested in doing new things. 1 2 3 4 5
8. I have a lot of concern for the well being of other people. 1 2 3 4 5
9. I'm an organized person. 1 2 3 4 5
10. I save money on a regular basis. 1 2 3 4 5
11. I do or say things that others find embarrassing. 1 2 3 4 5
12. People who are foolish enough to be taken advantage of deserve it. 1 2 3 4 5
13. I only have to make a mistake once in order to learn from it. 1 2 3 4 5
14. I tend to be an energetic person. 1 2 3 4 5
15. I make inappropriate sexual advances or flirtatious comments. 1 2 3 4 5
16. When someone is in trouble, I feel the need to help them. 1 2 3 4 5
17. I sometimes I lose track of what I'm doing. 1 2 3 4 5
18. I feel protective towards a friend who is being treated badly. 1 2 3 4 5
19. I think about the consequences of an action before I do it. 1 2 3 4 5
20. I lose my temper when I get upset. 1 2 3 4 5
21. I take other people's feelings into account when I do something. 1 2 3 4 5
22. I have trouble summing up information in order to make a decision with it.1 2 3 4 5
23. I start things, but then lose interest and do something else. 1 2 3 4 5
24. I swear/use obsecenities. 1 2 3 4 5
25. I don’t like it if my actions or words hurt someone else 1 2 3 4 5
26. I use strategies to remember things. 1 2 3 4 5

BRS

Please respond to each item by marking one box per row		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
BRS 1	I tend to bounce back quickly after hard times	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
BRS 2	I have a hard time making it through stressful events.	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
BRS 3	It does not take me long to recover from a stressful event.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
BRS 4	It is hard for me to snap back when something bad happens.	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1
BRS 5	I usually come through difficult times with little trouble.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
BRS 6	I tend to take a long time to get over set-backs in my life.	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1

PTGI

In this particular survey, you are invited to reflect on how you might have changed as a result of the COVID-19 crisis. Indicate for each of the statements below, the degree to which this change occurred in your life as a result of the COVID-19 crisis, using the following scale:

0 = I did not experience this change as a result of my crisis.
1 = I experienced this change to a very small degree as a result of my crisis.
2 = I experienced this change to a small degree as a result of my crisis.
3 = I experienced this change to a moderate degree as a result of my crisis.
4 = I experienced this change to a great degree as a result of my crisis.
5 = I experienced this change to a very great degree as a result of my crisis.

Possible Areas of Growth and Change	0	1	2	3	4	5
1. I changed my priorities about what is important in life.						
2. I have a greater appreciation for the value of my own life.						
3. I developed new interests.						
4. I have a greater feeling of self-reliance.						
5. I have a better understanding of spiritual matters.						
6. I more clearly see that I can count on people in times of trouble.						
7. I established a new path for my life.						
8. I have a greater sense of closeness with others.						
9. I am more willing to express my emotions.						
10. I know better that I can handle difficulties.						
11. I am able to do better things with my life.						
12. I am better able to accept the way things work out.						
13. I can better appreciate each day.						
14. New opportunities are available which wouldn't have been otherwise.						
15. I have more compassion for others.						
16. I put more effort into my relationships.						
17. I am more likely to try to change things which need changing.						
18. I have a stronger religious faith.						
19. I discovered that I'm stronger than I thought I was.						
20. I learned a great deal about how wonderful people are.						
21. I better accept needing others.						

Demographic and Lifestyle Questionnaire

In this study, we are interested in learning about childhood trauma survivors' experiences during the COVID-19 pandemic, and how mind-body therapies can help to improve survivors' resilience. We know from prior research that certain demographic variables can influence response to health pandemics and to therapy. Such variables include lifestyle, employment, physical and mental health, and also sex and gender. In this demographic questionnaire, we will be asking you about some of these personal questions, so that we can better understand who benefits from the therapy we are going to be providing.

Age: ____

Assigned sex at birth:

Male Female Intersex Other:_____

Gender (check any that apply):

Male Female Trans man/ male Trans woman/ female Non-binary

Gender queer/non-conforming Other:_____

Have you undertaken any of the following to medically transition sex (check any that apply):

Hormone Therapy

Oophorectomy (an operation to remove ovaries)

Other: _____

Ethnicity (check any that apply):

Caucasian Asian African Canadian

Middle Eastern Hispanic Other: _____

Highest level of education:

Elementary School High School Some College/University

College Diploma Undergraduate Degree Graduate degree or higher

Employment status:

Unemployed Part-time Full-time Disability Parental leave

Retired Other: _____

Income level:

<$15,000 $15,000 - $30,000 $30,000 - $45,000

$45,000 – $60,000 $60,000 - $75,000

$75,000 - $90,000 >$90,000

Do you have any religious or spiritual practice?

Yes No

If yes, which religious or spiritual practice(s) do you identify with?: _____

Do you smoke cigarettes or e-cigarettes?

Yes No

If yes, has your use of cigarettes or e-cigarettes changed since the onset of the COVID-19 pandemic?

Yes, it has increased Yes, it has decreased No, it has not changed

If you smoke/vape, how many days a week do you smoke/vape?_____

If you smoke/vape, how many cigarettes do you smoke each day (or equivalent)? _____

Do you drink alcohol?

Yes No

If yes, has your use of alcohol changed since the onset of the COVID-19 pandemic?

Yes, it has increased Yes, it has decreased No, it has not changed

If you drink alcohol, how many days a week do you drink?_____

If you drink alcohol, how many beverages do you typically have in one sitting? _____

Do you smoke marijuana or consume marijuana products?

Yes No

If yes, has your use of marijuana changed since the onset of the COVID-19 pandemic?

Yes, it has increased Yes, it has decreased No, it has not changed

If you smoke/consume marijuana products, how many days a week do you so?_____

If you smoke/consume marijuana products, how many grams do you typically smoke/consume in one sitting? _____

Do you have any respiratory conditions (i.e., problems with your breathing) such as asthma or bronchitis?

Yes No

Do you have any gastrointestinal conditions (e.g., inflammatory bowel disease, irritable bowel syndrome), or frequent gastrointestinal symptoms (e.g., bloating, abdominal pain, indigestion)?

Yes No

Have you ever tried any form of *moving meditation*, such as yoga, tai chi, qi gong, and conscious/ecstatic dance?

Yes No

If yes, which form(s) of moving meditation have you tried? (Check any that apply)

- Yoga
- Tai Chi
- Qi Gong
- Conscious/Ecstatic dance (e.g., 5Rhythms)
- Other: _____

Have you ever practiced any form(s) of moving meditation regularly (e.g., at least once every two weeks for a few months)?

Yes No

If yes, which form(s) of moving meditation have you practiced regularly? (Check any that apply**)**

- Yoga
- Tai Chi
- Qi Gong
- Conscious/Ecstatic dance (e.g., 5Rhythms)
- Other: _____

Have you ever tried any form of *seated or stationary* meditation?

Yes No

If yes, which form(s) of seated meditation have you tried? (Check any that apply)

- Mindfulness meditation
- Vajrayana meditation
- Theravada meditation
- Loving-kindness meditation
- Body scan/ Progressive muscle relaxation
- Breath awareness meditation
- Zen meditation
- Transcendental meditation
- Other: _____

Have you ever practiced any form(s) of seated or stationary meditation regularly (e.g., at least once every two weeks for a few months)?

Yes No

If yes, which form(s) of stationary or seated meditation have you practiced regularly?

- Mindfulness meditation
- Vajrayana meditation
- Theravada meditation
- Loving-kindness meditation
- Body scan/ Progressive muscle relaxation meditation
- Breath awareness meditation
- Zen meditation

- Transcendental meditation
- Other: _____

On average, how many hours of physical exercise (e.g., yoga, running, dance, weight-training, hiking, etc.) do you currently do each week? _____

On average, how many hours do you sleep each night? _____

Have you suffered from a head injury?

Yes No

If so, please indicate the severity of your most serious brain injury as diagnosed by a healthcare provider:

Undiagnosed Mild (i.e., Concussion) Moderate Severe

Have you ever struggled with a mental health condition (e.g., including but not limited to: depression, anxiety, attention-deficit hyperactivity disorder, learning disorder, panic attacks, post-traumatic stress)?

Yes No

If so, for each of the following mental health conditions, please indicate both (1) and (2):

(1) Whether you have struggled with the condition currently (i.e., within the last month) OR in the past.

(2) Whether you were formally diagnosed with the condition by a mental healthcare provider OR were self-diagnosed.

If you have not struggled with a particular condition, please select "NA".

- Anxiety (e.g., panic attacks, generalized anxiety, social anxiety)
- Depression
- Attention-deficit hyperactivity disorder (ADHD)
- Post-traumatic stress
- Substance abuse
- Bipolar disorder
- Psychosis
- Eating disorder
- Developmental disorder (e.g., Autism Spectrum, Intellectual Disability)
- Learning disorder

- Obsessive-compulsive disorder
- Personality disorder
- Dissociative disorder
- Disruptive, impulse control, and conduct disorders (e.g., Oppositional defiant disorder, Conduct disorder, Pyromania, Kleptomania, etc.)
- Other mental illness(es)

Have you ever received mental health treatment (e.g., psychotherapy, counselling, medications)?

Yes No

If yes, which form(s) of treatment have you tried? (Check any that apply)

Talk therapy or counselling (one-on-one) Group therapy Medication Other: _____

Are you currently receiving mental health treatment?

Yes No

Which form(s) of treatment are you currently receiving?

Talk therapy or counselling (one-on-one) Group therapy Medication Other: _____

Which psychiatric medication(s) are you currently taking? _____

Please indicate the total length of time that you have received mental health treatment (in months): _____

COVID-19 Experiences Questionnaire

The following questions pertain to your experiences during the COVID-19 pandemic. Specifically, the questionnaire seeks to understand (1) how the health crisis has impacted yourself, your loved ones, and acquaintances, and (2) how you are coping with the crisis.

Are you considered to be at high-risk for developing severe illness from COVID-19?

Yes No

Have you practiced *social distancing* due to COVID-19? That is, limiting in-person contact with others and maintaining a 2-metre distance from others.

Yes No

If so, what is the longest period of time that you have maintained social distance due to COVID-19? (in days) _____

Have you practiced *self-isolation* due to COVID-19? That is, staying at home and maintaining as much social distance as possible from the people you live with.

Yes No

If so, what is the longest period of time that you have maintained self-isolation due to COVID-19? (in days) _____

Have you been placed under *quarantine* by healthcare or travel professionals? That is, have you self-isolated because you were sick, travelling, or otherwise exposed to COVID-19?

Yes No

If so, for how many days were you under quarantine? _____

Do you live alone?

Yes No

Have you lost your job as a result of COVID-19?

Yes No

Have you had a substantial loss of income as a result of COVID-19?

Yes No

Have you had difficulty paying for necessities such as rent, food, or medication as a result of COVID-19?

Yes No

Do you have any dependents?

Yes No

If so, how many dependents you have? _____

Have you developed viral or flu-like symptoms during the COVID-19 pandemic?

Yes No

Were you formally tested for COVID-19?

Yes, tested positive for COVID-19 Yes, tested negative for COVID-19

No, but likely had COVID-19 No, but likely did not have COVID-19

Were you hospitalized (for any reason) for one or more nights during the COVID-19 pandemic?

Yes No

If yes, were you hospitalized specifically for corona virus type symptoms?

Yes No

Did you experience respiratory symptoms during the COVID-19 pandemic?

Yes No

Have any of your loved ones developed viral or flu-like symptoms during the COVID-19 pandemic?

Yes No

Were any of your loved ones formally tested for COVID-19?

Yes – one or more of my loved ones tested positive for COVID-19
Yes – my loved ones tested negative for COVID-19
No – but one or more of my loved ones likely had COVID-19
No – but my loved ones likely did not have COVID-19

Were any of your loved ones hospitalized for one or more nights (for any reason) during the COVID-19 pandemic?

Yes No

If yes, were any of your loved ones hospitalized as a result of corona virus type symptoms?

Yes No

Did any of your loved ones exhibit respiratory symptoms during the COVID-19 pandemic?

Yes No

Did any of your loved ones pass away (due to any cause of death) during the time of the COVID-19 pandemic?

Yes No

If so, did any of your loved ones die specifically due to COVID-19?

Yes No

As far as you know, were any of your acquaintances formally tested and diagnosed with COVID-19?

Yes No

Did any of your acquaintances die as a result of COVID-19?

Yes No

Are you a healthcare worker?

Yes No

If so, what is your profession? _____

Have you been working during the COVID-19 pandemic?

Yes No

During the COVID-19 pandemic, I have been working with patients primarily via:

Virtual communication (e.g.,Telehealth) Face-to-face patient contact
Not applicable (I do not have contact with patients)

During the COVID-19 pandemic, on average, how many hours per week have you been working? _____

Have your hours significantly increased as a result of the pandemic?

Yes No

Are you an essential worker outside of healthcare?

If so, what is your profession? _____

Have you been working during the COVID-19 pandemic?

Yes No

If so, have you been primarily working:

Remotely On-site

On average, during the pandemic, how many hours per week have you been working? _____

Have your hours significantly increased as a result of the pandemic?

Yes No

Have you used any of the following strategies to cope with stress related to COVID-19? (Check any that apply)

At-home physical exercise (e.g., weight-training, pilates, yoga, dance, tai-chi, treadmill)

Outdoor physical exercise (e.g., running, walking, hiking, swimming, climbing, biking)

Spiritual practice (e.g., prayer, meditation, yoga rituals, etc.)

Creative activities (e.g., playing a musical instrument, writing, arts and crafts, cooking or baking, etc.)

Maintaining regular communication with loved ones via phone, video-chat, or in-person socially distanced activities

Establishing and following a daily routine

Staying informed about COVID-19 updates

Maintaining boundaries around accessing COVID-19 related information (e.g., limiting social media or news exposure)

Maintaining a healthy diet

Enjoying fresh air and nature while following social distancing and isolation guidelines

Counselling via phone, video, or in-person

Helping other people who are in need

Other: _____

None of the above

Recent Experiences Questionnaire

This questionnaire inquires about changes in your life that might have occurred **while you were completing the yoga program or were in the waitlist stage of the study.**

Please indicate if you have incorporated any NEW self-care strategies into your life while you were completing the yoga program or in the waitlist stage. (Check any that apply)

At-home physical exercise (e.g., weight-training, pilates, yoga, dance, tai-chi, treadmill)

Outdoor physical exercise (e.g., running, walking, hiking, swimming, climbing, biking)

Spiritual practice (e.g., prayer, meditation, yoga rituals, etc.)

Creative activities (e.g., playing a musical instrument, writing, arts and crafts, cooking or baking, etc.)

Maintaining regular communication with loved ones via phone, video-chat, or in-person socially distanced activities

Establishing and following a daily routine

Staying informed about COVID-19 updates

Maintaining boundaries around accessing COVID-19 related information (e.g., limiting social media or news exposure)

Maintaining a healthy diet

Enjoying fresh air and nature while following social distancing and isolation guidelines

Counselling via phone, video, or in-person

Helping other people who are in need

Other: _____

None of the above

During your time in the yoga group or in the waitlist stage, did you experience any COVID-related changes or disruptions in your life?

Yes No

If yes, please briefly describe the COVID-related change(s) or disruption(s) that you experienced. _____

Weekly Check-in Email

Dear [Participant name]

This is the [first, second, third, fourth] of four weekly check-in emails that you are receiving as you move through the TIME Yoga Program. I am very curious about your experiences in the program! I would love to hear your responses to the following questions:

1. Have you attempted one, both, or none of this week's yoga sessions?

2. If you missed one or both of the sessions, what prevented you from attempting the session(s)?

For questions 3 through 8, please answer "NA" if you did not attempt any of the sessions. Please answer for each session:

3. Were you able to fit the session(s) into your regularly scheduled yoga days and times?

   Session [1,2,3,4,5,6,7,8]:

   Session [1,2,3,4,5,6,7,8]:

4. If you were not able to fit the session(s) into your regularly scheduled yoga days and times, what interfered with your yoga schedule?

5. Were you able to do the yoga session(s) in a private and quiet environment without disruptive interruptions?

   Session [1,2,3,4,5,6,7,8]:

   Session [1,2,3,4,5,6,7,8]:

6. If you were interrupted during the yoga session(s), who or what disturbed you (e.g., kids, pets, other people, construction noise, etc.)?

7. Approximately what percentage of the yoga session(s) did you complete? Please provide a percentage for each of the sessions that you attempted (e.g., " 70% of Session 1, 100% of Session 2)

   Session [1,2,3,4,5,6,7,8]:

   Session [1,2,3,4,5,6,7,8]:

8. If you did not complete 100% of the session(s), what interfered with you completing the entire session(s)?

9. I encourage you to reflect on whether you have noticed any shifts in your emotions… your body… your thoughts… your behaviour… your relationships. These shifts might be subtle or major.

   Have you noticed any major changes related to thoughts of harming yourself or another person? Please indicate if you are having serious and concerning thoughts of this nature. I may follow-up with you via phone to help ensure that you are safe.

10. Is there anything else that you would like to share about your experience in the TIME Yoga Program?

Your well-being is of upmost importance. Please reply to this check-in within the next two days. If I do not hear from you, I may try to reach you via phone to check-in.

Thank you in advance for sharing your experiences! I truly appreciate your engagement in the yoga sessions. I invite you to take a moment to feel gratitude towards yourself for your acts of devotion and self-care.

Warmly,

Kristen Silveira

Appendix B
Supplementary Data Analytic Tables

The following supplementary tables are included in this appendix:

1. Benjamini-Hochberg Procedure for Controlling the False Discovery Rate Across MAIA Subscale Regression Analyses
2. Benjamini-Hochberg Procedure for Controlling the False Discovery Rate Across ANCOVAs

Benjamini-Hochberg Procedure for Controlling the False Discovery Rate Across MAIA Subscale Regression Analyses

Outcome	*p*	Rank	Adjusted *p* value for significance
MAIA: Self Regulation	**.033**	**1**	**.030**
MAIA: Body Listening	**.050**	**2**	**.060**
MAIA: Noticing	.235	3	.090
MAIA: Attention Regulation	.131	4	.120
MAIA: Emotional Awareness	.214	5	.150

Note: Bolded p-values are statistically significant, with FDR of .15

Benjamini-Hochberg Procedure for Controlling the False Discovery Rate Across ANCOVAs

Outcome	*p*	Rank	Adjusted *p* threshold for significance
MAIA: Trusting	**<.001**	**1**	**.008**
MAIA: Self-Regulation	**.001**	**2**	**.015**
MAIA: Attention Regulation	**.003**	**3**	**.023**
MAIA: Body Listening	**.003**	**4**	**.030**
MCC N-Back	**.033**	**5**	**.038**
EFI Total Score	**.042**	**6**	**.045**
MAIA: Not-Distracting	**.057**	**7**	**.053**
PHQ-9	**.060**	**8**	**.060**
ERQ Suppression	.118	9	.068
PTGI Total Score	.142	10	.075
MAIA: Emotional Awareness	.231	11	.083
ISD Go/No-Go	.278	12	.090
MAIA: Noticing	.359	13	.098
ISD Flanker Incongruent	.500	14	.105
BRS	.623	15	.113
TAS Total Score	.687	16	.120
ISD N-Back	.728	17	.128
GAD-7	.759	18	.135
PCL-5	.871	19	.143
ACS	.894	20	.150

Note: Bolded p-values are statistically significant, with FDR of .15

Appendix C
TIME Yoga Manual

Overall Program Description

TIME yoga spans four weeks, with two weekly 60- to 75-minute sessions. The intervention encompasses four interrelated and progressive themes: *Grounding*, *Resourcing, Rhythms,* and *Play*. Each session is comprised of approximately 5 minutes of education, 15 minutes of meditation and breathing, and 45 minutes of asana. The practice is based on *anusara* sequencing, which is a type of hatha yoga that follows an arc-structure; it begins with centering meditation and breathing, followed by rhythmic warm-up movements, then transitioning from simple to complex postures with static holds, and including counterbalancing and cool-down postures before moving into final meditation and resting (Friend, 2006). Teachers can incorporate program themes into the opening meditation, and can use themes to guide selection of postures that belong to the specified asana families (e.g., standing asanas, basic hip-openers, backbends, etc.). TIME yoga is beginner-friendly; the first few sessions cover foundational postures and fundamental principles of breathing and physical alignment, and increasingly challenging postures are incorporated in the latter sessions. Each session includes reference to one or two relevant sources from the trauma literature, for participants who are interested in learning more about the techniques or theme.

Participants' Safety

Importantly, safeguards are in place to mitigate participants' risk of adversity. A common risk in any trauma intervention, or in any mindfulness or yoga practice, is that participants may develop greater awareness of distressing experiences, and may feel worse before they feel better. While this awareness is viewed as part of the intervention, the sessions are structured in a gradual and skills-building format, to help participants develop distress-tolerance skills. In the

initial study of TIME yoga, exclusion criteria were applied to participants in order to mitigate risk (see Methods). Further, upon entering the study, participants were given a list of resources, which included examples of soothing or pleasurable activities for coping with distress, and local counselling and crisis resources. Additionally, participants received weekly check-in emails that inquired about program adherence and self-harming behaviours. Participants had provided personal and emergency contact information to enable the teacher to follow-up as required. Future TIME teachers should consider how these mitigation strategies apply to their population, and whether others are necessary and appropriate.

Noteworthy Elements of TIME Yoga

Some aspects of the program (i.e., psychoeducation, "extremes", and touch) may be novel relative to other trauma-sensitive programs that teachers may be familiar with. This section contains rationale and recommended processes for incorporating these elements.

Psychoeducation. While asana, breathing, and meditation remain present-focused, education about trauma is incorporated at the beginning of each session. The first step to helping an individual feel safe is supporting an understanding that they have not done anything wrong or bad (Porges, 2017). It is important to convey that individuals' bodily reactions were adaptive and even heroic at the time of the trauma, and although it makes sense that their body may respond similarly in the present, this adaptive feature is flexible and amenable to change in safe contexts. Education can address feelings of guilt and shame, as well as defensiveness and resistance to change. According to an expert clinician survey by the ISTSS (e.g., Cloitre et al., 2011), education was among the first-line interventions that acceptably promoted patient engagement, responsiveness, and retention, while mindfulness was named a second-line intervention.

Playing with extremes. TIME yoga offers participants movement and breathing techniques to expand their window of tolerance through evoking "extremes" of hyper- or hypo-arousal. This exploration follows Levine's (1997) somatic experiencing principles of resourcing, titration, and pendulation (e.g., Payne et al., 2015). That is, extremes are incorporated into later yoga sessions, after participants have mastered foundational postures and breathing, and have explored a soothing place of resource to refer to within their bodies. Participants are gradually invited to try new techniques one step at a time, in a titrating manner. They are empowered and trusted to choose whether to try any given movement, or to return to a less extreme variation of the movement or to a place of resource. This process resembles pendulation between states of relative contraction and expansion, as well as an important aspect of secure attachment, which is a balance between exploring unfamiliar territory and returning to a nurturing home base (e.g., Ainsworth, 1985).

Variations of extremes are framed as options to "play" with, thus emphasizing participants' choice in the experimentation, and reducing risk of a perfectionistic drive to "achieve" postures that are perceived as advanced. Moreover, play is a form of experiencing vagally-regulated sympathetic arousal, without stress, fear, aggressiveness, or defensiveness (Porges, 2017). By maintaining an even breathing rhythm and attending to a bodily resource during extremes, participants can find a state of equanimity and perhaps acceptance, in the midst of physical, mental, and emotional challenges (e.g., Schmalzl et al., 2015). Sometimes. extreme postures require intense focus on the body (i.e., to maintain muscular engagement, balance, and alignment), and may in and of themselves be resources for grounding in the present moment.

Extremes include physically strenuous postures such as arm balances and inversions, as well as postures targeting potentially vulnerable areas of the body, such as the belly and chest.

Back-bending and core-strengthening postures function to expand the rib cage and strengthen diaphragmatic muscles, which helps to deepen the breath, enhance baroreceptor sensitivity, and stimulate vagal afferents (Schmalzl et al., 2015). Breath regulation may also simulate vagal afferents, through techniques such as constricting the throat (*ujjayi*), breath retention, rapid exhalations followed by holding the breath (*kapalabhati*), and alternate nostril breathing (*nadi shodhana*). Overall, biomechanical changes during novel movements are thought to alter pulmonary and cardiovascular functioning (Gard et al., 2014). Another modality of play and exploration is shaking the body. In somatic experiencing, shaking is coupled with trauma story processing, to allow individuals to "discharge" events. In TIME yoga, shaking is a standalone playful technique in postures such as "dead bug" (i.e., lying on back with limbs raised), which encourages fun and creativity, and also increases participants' movement repertoire. This is somewhat similar to trauma release exercises (TRE; Berceli, 2010), which involve shaking muscles that habitually contract with stress, in order to calm the nervous system; "neurogenic tremors" are induced in the lower body, particularly the psoas muscles, via exercises such as holding a squat position until the legs are exhausted and begin to tremble.

Touch. Touch can be a therapeutic tool for finding a sense of comfort, invigoration, connection, and nurturance, especially in the context of a neglectful caregiving relationship which was depriving of touch (e.g., Perry, 2008). Thus, TIME yoga participants are encouraged to engage in guided self-massage as method of self-soothing.

Session-by-Session Content

Program content is outlined in Table 1. The intention of this manual is to offer teachers general facilitation guidelines within each theme, rather than prescribing them a rigid protocol. This is to encourage knowledgeable trauma-informed teaching that is also intuitive and mindful

of the state and needs of the participants, as well as the style of the particular teacher. The expectation is that through training, teachers develop a certain expertise in both yoga and trauma, and that they are comfortable with teaching material within the framework below.

Table 1.

TIME Yoga Content

Sessions	Theme	Education	Intention	Pranayama	Asana
1 - 2	Grounding: Centering oneself in the here-and-now	The traumatic stress response Manifestations of fight/flight/freeze in brain, body, and behaviour Grounding techniques: (1) attending to body parts physically touching ground; (2) noticing and labelling characteristics of bodily sensations and breath (e.g., location, temperature, intensity, weight, shape, size, movement, colour, sound); (3) orienting 5 senses to environment Conscious breath regulation as method of managing unconscious physiological processes	"I am __" (e.g., I am listening to my body; I am here)	*Sama vritti* (i.e., inhales and exhales of equal length) *Ujjayi* (i.e., oceanic-sounding breath created by widening back of throat) Bumblebee breath (i.e., audible exhales through closed lips)	Postures that explore contact with floor (e.g., mountain, tree, child's, warriors, bridge, reclined spinal twist) Postures that evoke obvious physical sensations, especially those involving downward pressure (e.g., yogic squat, goddess, forward folds)

3 - 4	Resourcing: Using body as a resource for safety, love, or pleasure Participants are guided to find areas in their body in which they sense softness, comfort, gentleness, ease, warmth, stability, energy, strength, lightness, etc. They also learn to evoke these feelings through touch and imagery (e.g., in *savasana*, visualizing being surrounded by a golden light shimmering with any desired feelings; in opening or closing meditation, visualizing a smile or object of gratitude, and noticing how image lands in the body)	Window of tolerance: Emotions and behaviours associated with optimal arousal versus hyper- or hypo-arousal; resourcing is a way to regulate arousal Attachment: Resourcing as a way of exploring a secure base – similar to how an infant uses a caregiver as a secure base – from which one can investigate new or uncomfortable experiences	Based on desired feeling that would meet a current need (e.g., I am: empowered, relaxed, soft, spacious, joyful, or energized)	3-part breath (i.e., breathe sequentially into lower belly, rib cage, and chest)	Postures that complement 3-part breath and expansion of torso (e.g., dancer's, exalted warrior) Exploring movements and touch that feel good (e.g., placing hands on belly and heart, tapping legs to energize muscles, massaging feet in butterfly pose, rolling forehead or lower back on mat for self-massage)
5 - 6	Rhythms (i.e., of body and breath): Noticing the rhythm of breath, listening to the body and choosing movements that feel good, synchronizing movement with breath, and synchronizing with other beings	Attachment as a process by which caregiver regulates infant's needs, and a synchronous relationship can develop and include alignment of heart and breathing rate Regardless of caregiver history, everyone can develop a synchronous relationship within their own bodies by attuning and responding to needs at this time Circadian rhythms and associated	E.g., I am: following my breath; listening to my body	Earth breaths (i.e., sit with grounding *mudra* or hand gesture of pointer and middle fingers on ground; notice the earth as supportive and solid being that generates and receives energy; inhale energy upwards from the earth and exhale energy down towards earth) Sun breaths (i.e., moving	Focus on synchronizing movement with breath (e.g., cat-cow, sun salutations) Incorporate self-led sequences without teaching cues, in order to encourage participants to sustain home practice

		COVID-19 disruptions Consistent yoga schedule and attuning to breath and movement as regulating strategies Reminder to use grounding or resourcing skills in event that rhythmic practices evoke "auto-pilot" processes, tuning out from body, or dissociation		arms up and down in synchrony with ujjayi sound and direction of inhales and exhales; as in Emerson & Hopper, 2011) Nadi shodhana (i.e., alternate nostril breathing; intended to balance and ground the body and help with insomnia)	
7 - 8	Play: Playing with the more extreme ends of yang and yin energies (i.e., movements that are more fact-paced, heating and energizing, balanced with those that are slower, cooling, and relaxing) Participants are encouraged to explore less comfortable physical experiences in a gradual manner, with attitude of playfulness and curiosity (vs. perfectionism or self-punishment) Sessions begin with grounding and resourcing, and these tools are encouraged throughout	Widening the window of tolerance through play Somatic experiencing theory: Animals in the wild release trauma by shaking, moving limbs, and deep belly-breathing	Participants set their own intentions for practice	*Kapalabhati* (i.e., deep inhale through nose followed by pumping diaphragm to create several sharp exhales through nose; energizes, activates, and clears the body) *Sitali* (i.e., open and purse lips, stick tongue out, and breathe through rolled or flat tongue; slows breath and cools body)	Yang postures (e.g., chair, boat) Yin postures (e.g., reclined butterfly, pigeon, gentle neck rolls) Shaking can be explored (e.g., in reclined dead bug or standing mountain)

Note: Within the grounding theme, the yoga practice varies from session one to two, in order to expose participants to an array of foundational postures from each of the asana families. Within each of the remaining three themes, the asana and pranayama sequences are identical across the two sessions, so that participants have two opportunities to explore, settle into, and internalize the practices.

General Teaching Guidelines

According to practice recommendations by Cook-Cottone and colleagues (2017), trauma-informed yoga teachers should have an understanding of yoga and trauma, as well as their scope of practice in delivering the intervention. Considering the neuropsychological principles involved in TIME yoga in particular, yoga teachers who wish to offer this program must undergo trauma-informed yoga teacher training and possess a graduate degree in a mental health field such as psychology, psychiatry, or social work. These two competencies are pertinent to understanding both Eastern and Western theories of trauma and self-regulation strategies that are incorporated in TIME yoga, as well as such topics as scope of practice, recognizing and responding to distress, community referrals, and ethical considerations in mental health (e.g., navigating dual relationships with participants, confidentiality, privacy). TIME teachers are required to develop an understanding of theories of complex trauma and self-regulation difficulties, including those outlined in Chapter 4 of this dissertation.

TIME teachers embody an attitude of curiosity and openness towards one's experience. Teachers empower practitioners to make choices about their bodies through using invitational language and providing options for modifying postures. Teachers give clear, simple, and repeated instructions, which are suitable for beginners. In cases of dysregulation and dissociation, participants may have attentional and memory difficulties, and would benefit from continuous prompting to attend to the body and breath.

Teachers can orient participants to the program themes and structure at the start of the first session, or in a separate introductory session. At this point, they should introduce themselves and their credentials (e.g., RYT-200), and clarify that they are acting in a yoga teaching capacity, rather than as a therapist or counsellor. They should convey that they will offer guidance and suggestions; participants should listen to their own body's needs first and

foremost, and modify postures or take rest accordingly. The teacher should also inform participants about household items they may use as supportive props (e.g., books, soup cans, cushions, blankets). The teacher would also model use of props in-session.

If practitioners share traumatic or otherwise personal information via email or phone, the teacher may provide supportive comments (e.g., "I hear you, that sounds like a difficult situation") but not counselling. The teacher should have a referral list of community-based resources, including counselling and suicide hotlines. Teachers should refer to the "Participants' Safety" section above for additional considerations around mental health and active distress.

Teachers should acknowledge that TIME themes and techniques may seem unfamiliar. Participants are encouraged to be kind to themselves and allow for time and practice to gain comfort with the material they are learning. Each time they practice a technique, such as bringing the mind back to the present moment, they are forging neural pathways. Notably, mixed and strong feelings are common when learning about trauma. Especially in relation to concepts of attachment and caregiving, participants may feel a sense of anger or loss. Participants are encouraged to work with distressing emotions as part of their yoga practice. That is, they can notice and name the emotions and sensations, including numbness, and watch the experiences rise and fall, knowing they can always return to a resource.